APPLES AND PEARS

VARIETIES AND CULTIVATION IN 1934

REPORT
OF THE
CONFERENCE
HELD BY THE

ROYAL HORTICULTURAL SOCIETY

at the Crystal Palace, Sept. 19–21, 1934

338

EDITED BY

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CONFERENCE
ON
APPLES AND PEARS

HELD BY THE ROYAL HORTICULTURAL SOCIETY,

SEPTEMBER 19–21, 1934, AT THE

CRYSTAL PALACE.

PRESIDENT.

The Lord ABERCONWAY, C.B.E., President, Royal Horticultural Society.

A CONFERENCE on Apples, Pears and Plums was arranged by the Royal Horticultural Society for 1934, and held at the Crystal Palace, on September 19–21, at the time of the Great Autumn Show.

The Council appointed the following Committee to make arrangements for the Conference (p. 2), for the exhibition of varieties of Apples which was arranged at the same time at the Palace (p. 179), and for the excursion of members of the Conference to the Commercial Fruit Trials at Wisley, on the Saturday following.

CONFERENCE COMMITTEE.

Chairman.

E. A. BUNYARD, Esq., F.L.S.

Vice-Chairman.

C. G. A. NIX, Esq., V.M.H.

Professor B. T. P. BARKER, M.A.
H. T. BARNETT, Esq.
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H. SOMERS RIVERS, Esq.
CUTHBERT SMITH, Esq.
H. V. TAYLOR, Esq., B.Sc., O.B.E.
P. DEBELL TUCKETT, Esq.

The Council desires to place on record its appreciation of the efforts which enabled the Conference and Exhibition to be arranged and carried to a successful conclusion, and especially to the Chairmen of the meetings, the readers of papers, and to those who collected and sent the numerous varieties of Apples which were exhibited, and which made this Exhibition more comprehensive and representative of British varieties of apple than any held during the past fifty years.

The Papers read at the Conference and the discussions following each are printed in this Report, and in addition some papers on related matters have been interpolated so as to make the Report as generally useful as possible. For full list see Contents.

The programme of the Conference was as follows:

FIRST SESSION.

Wednesday, September 19, 1934, at 3 P.M.

Chairman.

The Lord ABERCONWAY, President, R.H.S.

1. Opening Address: The Lord ABERCONWAY (p. 3).
2. "Winter Pruning of Apples, Pears and Plums": Mr. J. WILSON (p. 7).
3. "Summer Pruning of Hard Fruits": Mr. A. H. LEES, M.A. (p. 14).

SECOND SESSION.

Thursday, September 20, 1934, at 11 A.M.

Chairman.

Sir FREDERICK KEEBLE, M.A., Sc.D., F.R.S., F.L.S.

4. "The Basis of Classification of Apples and Pears": Mr. E. A. BUNYARD, F.L.S. (p. 47).

THIRD SESSION.

Thursday, September 20, 1934, at 3 P.M.

Chairman.

Sir JOHN RUSSELL, D.Sc., F.R.S.

5. "Orchard Factors affecting Fruit Quality": **Dr. T. WALLACE** (p. 98).

FOURTH SESSION.

Friday, September 21, 1934, at 11 A.M.

Chairman.

Sir WILLIAM G. LOBJOIT, O.B.E., J.P., V.M.H.

6. "The Fruit Trials at Wisley": Sir DANIEL HALL, K.C.B. (p. 121).
7. "New Varieties of Apples and Pears": Mr. A. N. RAWES (p. 126).
8. "The Fruit the Public Wants": Mr H. L. TAYLOR (p. 136).

FIFTH SESSION.

Friday, September 21, 1934, at 3 P.M.

Chairman.

Mr. SPENCER W. MOUNT.

9. "Pears from a Commercial Aspect": Mr. THOMAS NEAME (p. 146).
10. "Stocks for Pears": Mr. R. G. HATTON, M.A., V.M.H. (p. 154).
11. "Storage of Apples": Dr. KIDD and Dr. WEST (p. 167).

THE CONFERENCE.

OPENING ADDRESS.

By the Lord ABERCONWAY, President, R.H.S.

I RISE formally to open this Conference on Apples and Pears, and my first duty is to express the debt of gratitude that the Royal Horticultural Society bears, and indeed that all growers should bear, to the Conference Committee whose Chairman, Mr. BUNYARD, is here with us to-day, and to those who have taken the trouble to prepare the Papers which are to be read and who are willing to give their knowledge so generously for the common good. Those of you who have read the Programme will acknowledge that the Papers will be of interest to the commercial grower, to the amateur grower and also to the professional gardener.

This is not the first Conference of its kind. To be strictly accurate, I presume that the first conference on apples took place in the Garden of Eden, and, of course as you know, it was disastrous. I would point out those were the days before science entered into the cultivation of apples. If an appropriate winter wash had been used I am informed by experts that the serpent would have been controlled in the egg-stage. The march of science has been considerable since then, and I believe the only snakes now seen in apple trees are seen by those who have drunk too deeply of some of the more potent forms of cider.

Undismayed by the result of that first unfortunate precedent, the Royal Horticultural Society held a great Apple Conference, the National Apple Congress of 1883, in their grounds at Chiswick. That was a very successful affair. An excellent Report was published entitled "British Apples." It was very soon sold out, but many of you no doubt possess it. Then in 1888, five years later, the Royal Horticultural Society had a National Apple and Pear Conference which was also successful. In 1905 a Conference was held which dealt mainly with transport questions. Transport questions were more acute in those days. Nowadays railway companies have an increasing appreciation of the importance of the fruit industry, and of the fruit traffic, and with, perhaps, the added stimulus of motor competition have greatly improved the transport conditions. The next event of importance fathered by the Royal Horticultural Society was the establishment in 1922 of the Joint Fruit Testing Committee, a Committee partly representing the Board of Agriculture and partly representing the Royal Horticultural Society The Board of Agriculture gave a grant and when the Committee met in 1922 under the Chairmanship

of our old friend who has done so much for fruit culture, Sir WILLIAM LOBJOIT, their objects were very well expressed as follows :—

> "The primary object in the testing of new varieties of fruit is to show their potential values for market purposes in order to bring prominently before growers varieties of exceptional promise at the earliest possible moment, and to afford an opportunity to them to see them growing on a sufficient scale. Other objects are to define the characters of varieties under trials and to compare them with known varieties, so that accurate descriptions may be made, synonyms determined and the nomenclature of the fruits made more exact."

That original statement of the objects very well sums up the work that has been done by the Joint Fruit Testing Committee. They planted in 1922 two acres at Wisley; in 1934 there were 38 acres under fruit cultivation. There are now 300 varieties of hardy fruits under trial and no fewer than 1,300 varieties in the collection of Standard Fruit Trees. When the new varieties show sufficient promise in the Trial Grounds at Wisley, they are grafted on different stocks and distributed among ten sub-stations all over the country in order that each variety may be tried out in different climatic and soil conditions. You will see the evidence of that work to-day in the Hall because the Wisley establishment is exhibiting firstly, a collection of fruit; secondly, a collection of the new apples which are now under trial; thirdly, a collection of the apples which have passed through the ordeal of that first trial and have been selected for testing at sub-stations; and fourthly, apples for private gardens. In this connexion I must congratulate those at Wisley on a further exhibit consisting of a very large collection of apples grown all over the country with specimens of foliage attached, shown in order to assist people in identifying any apples they may grow in their gardens. I should like to take this opportunity of expressing the gratitude of the Society's Council to those voluntary workers who have been good enough to contribute to that collection.

Lastly, viewing the activities of the Royal Horticultural Society in fruit matters, we have the Conference that opens to-day. I think these activities on the part of the Society show that we appreciate very fully how important an industry fruit-growing and apple- and pear-growing is to-day. In 1934—I was very much surprised at the figure—there was in England and Wales over a quarter of a million acres devoted to orchards, 254,700 is the precise figure. That is without counting some 60,000 acres devoted to small fruit culture, and without counting Scotland or Northern Ireland. What is even more interesting is, that the acreage figures of 1934, compared with those of 1933, show an increase of no less than 5,100 acres, an increase which is just twice the average increase of the two previous years.

But I would venture to suggest, that in spite of this very big growth of fruit-growing in this country, there is room for further expansion.

The imports of apples and pears from foreign countries are still substantial, quite apart from what we get from the Dominions which stand in rather a different category, for we import to-day no less than one and a half million cwts. a year from foreign sources. Of course, a certain proportion of this import, as well as a very large proportion of the Colonial import, comes from the Southern Hemisphere, and arriving as it does in the late Spring and early Summer, it is only to a very small degree competitive with English produce. Indeed it is probably rather a help to the English grower in keeping the apple habit firmly fixed in the minds of the people.

The commercial fruit trade has made great strides in recent years, and I think that they are very much to be congratulated on their enterprise and their resources. They have improved their packing, their storing, their carriage arrangements and their grading. They produce a better product as well as more of it. I do think, however, that one point needs more attention although I know that the subject has been enquired into, that is, the very great discrepancy between the wholesale and the retail price of fruit. I am not one of those who would be disposed to grudge the retailer his fair profit. There are various things to take into account, losses, bad debts, services, especially the fact that people generally want the goods delivered at their houses. Furthermore, there has been a general increase of retail prices as compared with the wholesale. It is very remarkable that two or three years ago when wholesale prices were at their very lowest and when the wholesale price of all food and raw material was substantially less than it was before the War, the retail prices were something like 40 per cent. above pre-War prices, showing a very remarkable rise in the cost of retail distribution. This general rise in the cost of living was to some extent attributable to the fact that many of the articles consumed were manufactured goods, such as bread, and those manufactured goods have had a higher scale of wages applied to them in the process of manufacture. Now that does not apply to fruit or apples and pears. It is merely the cost of distribution that has to be taken into account, and I wish very much that more thought and attention could be given in the interest of fruit growers to the cheapening of the costs of distribution. If one could do that, one could get a large additional consuming public. That potential consumer, the small boy, is quite cold at the idea of a Ribston Pippin at 4*d.*, or even 2*d.*, a time, but if you could give him his apples at five or six to the penny, in many cases his life would be one perpetual feast.

There is one other point that I would like to mention, and that is the great advantage that commercial fruit growers enjoy in that so many amateurs, many of then employing highly skilled professional gardeners, are also interested in the growing of fruit. They have, in these amateurs, a body of very skilled men, taking a great interest in the question and trying out fruits in all parts of the country. We are very glad indeed as a Society to do what we can to encourage the growth of fruits by amateurs by holding a competitive Show as we do

each Autumn. It is an example of what can be done in a very poor soil if we remember that the first prize, as I have just learned, for the commercial class of Worcester Pearmain, has been won by one whom we do not think of as a skilled horticulturist, Mr. LLOYD GEORGE, who grows his fruit on an extremely unfertile soil in Surrey. It is to co-ordinate the efforts of the amateur, it is to bring before the apple-growing and the apple-eating public the results of our research at Wisley, that this Conference has been called for 1934. I now formally open it and wish the proceedings and the readers of the Papers every possible success.

I have very great pleasure in calling on Mr. JAMES WILSON, a very noted gardener, to read a Paper on the Winter Pruning of Apples, Pears and Plums. No one who has seen his fruit can doubt that he is very well qualified indeed to give us information on these subjects.

THE WINTER PRUNING OF APPLES, PEARS AND PLUMS.

By J. Wilson.

In dealing with the subject of Winter Pruning it must be borne in mind from the onset that opinions differ considerably as to the most effective methods. On the one hand are those who practise very hard pruning and on the other, those who take an entirely opposite view.

One fruit grower practises a method whereby he is most successful, yet the same treatment under entirely different conditions might prove unsatisfactory. Pruning cannot be carried out successfully by rule of thumb, because the factors which govern the growth of a tree vary considerably in different localities.

If stereotyped methods could be adopted and we could definitely say the leader can be pruned to so many inches in length and the laterals to a given number of buds, then pruning would be an easy matter, but as this is not possible, it must be done intelligently, taking into consideration all the factors that govern it.

All who cultivate fruit trees have, or should have, one aim, the production of good quality fruit every year.

Fruit trees are liable to make vigorous growth at the expense of fruit, or, on the other hand, they may be stunted with little or no growth, bearing small useless fruit. To help the inexperienced to avoid or remedy these extremes is the aim of my lecture, and if it be of a elementary character I trust the expert will be a little forbearing.

It is no exaggeration to say that pruning is one of the most fascinating and, at the same time, most abused operations connected with horticulture. By noting a fruit tree either in flower or carrying fruit and the effect of the previous pruning, observation can play a most important part in assisting to master the art of pruning. A means of acquiring knowledge of pruning is to make oneself familiar with the build of the various fruit trees, and probably the easiest way to become familiar with the make-up of a tree is to remember that all forms of fruit trees dealt with under the heading of this lecture are composed of cordons in some form or another.

A true cordon when fully developed is more or less a straight branch with fruiting spurs at intervals along its entire length. If all, or at least most forms of fruit trees are comprised of cordons, the next thing is to ascertain how cordons are developed.

When in the process of formation cordons are made up of parts known as leader, laterals and spurs.

The first thing to consider is why pruning is necessary, and its results.

The objects of pruning are :

(*a*) To form the tree : all the various trained forms are obtained by pruning.

(*b*) To regulate fruiting, and improve the quality of fruit, and in some instance to reduce the quantity. (Trees left unpruned frequently produce large crops of undersized fruit.)

(*c*) To admit to all parts of the tree their due share of light and air.

(*d*) To keep the tree of a manageable size so as to facilitate cultural operations such as gathering of fruit, spraying, etc.

(*e*) To remove dead, damaged and diseased wood.

The factors which govern the rate of growth must be taken into account and can be enumerated as follows :

(*a*) *Soils.*—Trees growing in soil naturally rich or containing an excess of nitrogenous manures make exuberant growth whereas, the other end of the scale, soil in an impoverished condition has a stunting effect. Correct pruning can help to modify this state of affairs.

(*b*) *Stocks.*—These are not the difficulty they were a few years ago, having now been graded for various purposes and forms of fruit trees, and all reliable nurserymen use these selected stocks when working their trees.

(*c*) *Rainfall.*—This has a marked influence on the growth of a tree. Some districts naturally have a larger rainfall than others. On the other hand, seasons vary in the quantity of rainfall, but it is the amount which falls during the spring months which influences the growth of trees.

(*d*) *Variety.*—This plays an important part in the question of pruning. Some varieties are naturally very free in fruiting, whereas others are just as shy and the same kind of pruning given to both would be ineffective for one or the other.

(*e*) *Form.*—The form of the tree and the purpose for which it is intended, must naturally have a bearing upon the kind of pruning necessary. The same variety of tree in various forms calls for different pruning. Age of the tree is another factor: young and old trees usually require reverse treatment.

The chief forms in which apple and pear trees are usually grown are: cordon, espalier, bush and standard. Plums are mostly grown as bush, standard and fan-trained trees. As already mentioned these forms are composed of cordons (except in the fan-trained trees) : the simplest method is to see how cordons are developed. The amateur usually buys trees already trained from a nursery, whatever the form may be. As an example we will assume that a two-year-old cordon has been purchased and this should comprise a leader (about two feet in length) and the main stem with its laterals and roots.

Cordons.—These are usually trees with a single stem known as single cordons or they may have two or three stems to one root stock, and then they are termed double and treble cordons respectively. In this form it is possible to grow them upright, horizontal, or at an angle of 45 degrees. In many instances the last method is a means

of checking the vigour of strong growing varieties. The advantages of trees in this form are they can be restricted, and are therefore suitable for small gardens to cover the sides of dwelling-houses and buildings, or a trellis by the side of a garden path, are under control, and if managed correctly, produce the finest fruits. Many varieties can be grown in a small area.

Espaliers.—The espalier consists of several horizontal cordons growing from a central stem. The horizontal branches vary in number but are usually about five placed twelve inches apart on each side of the stem. This type of tree is very valuable for small gardens and, like the cordon, it is easy to manage. Grown alongside paths of the kitchen garden they take up very little space and at the same time do not overshadow their near neighbours to any extent.

Bush Trees require much more space to develop than the last two forms, and are not really suitable for small gardens unless they are weak-growing varieties. Bush trees are really a multiplication of cordons radiating from a leg which should be quite clean to two feet above ground level. The cordons in this instance are not so straight and defined as in the true cordons and espaliers, yet none the less they are there.

Standards are similar to bush trees save in the length of the clean stem, about four feet in half standards, and six feet or more in a full standard. These trees are really only suitable for orchard cultivation : a fully developed tree would crowd a small garden. Once this type of tree is formed, very little pruning beyond cutting out an occasional crossing branch is necessary.

For the purpose of illustrating pruning, it will be advisable to take each part of the cordon separately, commencing with the leader.

The Leader.—The treatment of the leader is probably the most important of all. The length to remove varies according to several circumstances, these being variety, soil (moisture and food content), establishment and age of tree. The function of the leader is to enable the tree to fill its allotted space, as it is really the extremity of the branch, and the branches in their turn hold the fruiting spurs. An apple or a pear cordon, correctly balanced, should have a leader growth at the end of the growing season of about two to three feet.

The cutting of the leader controls to some extent the vigour of the tree and has the effect of helping or retarding spur formation. The wrong treatment of the leader can do irreparable damage to the future of a young tree and delay the commencement of the fruiting period considerably. Take, for instance, the tree on which the whole growth is vigorous ; if the leader is shortened severely this will cause the tree to form a mass of vegetative growth, forcing what might have been fruit buds under correct treatment into lateral shoots.

On the other hand, a leader not cut back sufficiently would cause a tree to settle down and fruit prematurely at the expense of growth ; fruit buds would form at the extremities of the leaders only, leaving bare spaces on the rest of the growth.

Pruning the leader the correct length induces the tree to form fruit buds naturally and evenly along the entire branch, but at the same time a certain amount of lateral growth should be produced.

A rough guide for the pruning of the leader is as follows:

If the tree is making the average amount of growth, reduce the leader about one half of its length; where growth is vigorous cut away a third; in a tree making poor growth, the leader must be cut hard back, leaving only a quarter of its length or even less. Leaders should always be cut at the proper point, just above a bud, neither too high nor too low; the former leaves a small portion of wood above the bud which usually dies, causing the wood to die beyond that point. Another source of trouble in this respect, is that the resultant growth is misplaced and the whole symmetry of the branches spoiled. Cutting too near a bud weakens the growth produced, thereby causing malformation.

The cut should be to a bud pointing the way the branches require extension. This is usually to an outside bud, but in varieties which are naturally of spreading or drooping habit, the cutting is made at a top or inside bud. In some instances another leader can be substituted where the existing one is growing in the wrong direction or has been damaged.

The Laterals.—The treatment of lateral growth calls for much care, for what is considered the correct treatment in one instance would prove the opposite in another. It is as well to consider the object of cutting laterals. If left to develop at will in unrestricted form, the trees would become a tangled mass of whippy shoots and would defeat the object aimed at. The main reason for cutting back the laterals is to encourage the tree to form fruiting spurs as close as possible to the main branches, and in so doing aid the fruit to get those benefits which correct pruning provides.

Fruit spurs are of two kinds, those naturally formed and those which are the result of spurring back lateral growth. In some instances natural spurs form readily if conditions are well balanced; many varieties of pears and some of the free-cropping apples make this kind of fruit spur readily. In the plum it is almost imperative for the well-being of the tree that natural fruit spurs should be induced to form.

Artificial fruit spurs should form on the lateral which has been cut back. These do not always form the first year on the short spurs on which it is intended. Often the cut back portion gives rise to another lateral growth (especially if the tree is at all vigorous) which in turn is cut back a year later to induce it to form a fruit bud.

When cutting a lateral the length of growth to leave varies from two to five or six buds. Varieties which are termed free croppers, and make comparatively weak growth, will need the hard pruning, and the stronger growing and shy fruiting varieties the lighter pruning. The amount of growth to leave depends upon the soil and rainfall, vigour and age of the tree, variety, etc.

In the few cases where it is almost impossible to form a fruit spur by cutting the lateral growth, thinning the branches should be resorted to.

To be able to grasp the meaning of lateral pruning, it is as well to note the result at the end of the season after pruning, as either of the following things may have happened:

(*a*) A fully developed fruit bud has been formed.

(*b*) An intermediate or half developed fruit bud has been formed.

(*c*) The shoot has given rise to another vegetative growth.

(*d*) Fruit buds and laterals have developed on the same spur.

The ideal to be aimed at is fruit buds predominating with just a sprinkling of lateral growth: this would be considered a well-balanced state of growth.

In the treatment of laterals many puzzling points arise and how to deal with them successfully often calls for much thought. There is the tree in which all or the majority of the laterals are very strong, and to cut all these back hard would only mean a further crop of laterals the following season. Ruling out the question of root pruning or ringing in this instance, the best treatment would be to prune these laterals lightly, leaving five or six buds. The result in the following season would most probably be some fruit buds and weaker laterals on the portion left. In the following season many of the laterals which were left so long the previous season can be cut again, but this time right back to a fruit bud which was formed by the light pruning, whereas other laterals may be cut entirely away as the tree should have become less vigorous.

There is the tree which produces a few very strong laterals or even what are termed water shoots, these wherever possible can be cut entirely out, leaving the tree furnished with enough spurs of the right vigour.

For the purpose of spur formation, apples can be divided into three groups (*a*) those which form spurs readily like the variety 'Keswick Codlin,' (*b*) those which form spurs tardily as in the variety 'Langley Pippin,' (*c*) those which do not form fruit spurs by pruning as in 'Irish Peach' Apple or 'Jargonelle' Pear.

The first-named group can be pruned quite hard, all other conditions being equal.

Group two requires the spurs to be left long, say about five buds, and any short lateral up to about five or six inches in length left entirely unpruned. These are known as dards, and it is on these short stubby shoots that most of the fruit is borne until the tree has settled down to fruit on shorter spurs.

Varieties in group three are fortunately very few. These bear their fruits on the tips of their laterals, refusing to form artificial fruit buds. The best treatment once the tree is formed is to thin the branches lightly, or to grow them as standards, allowing all the necessary freedom. 'Irish Peach' and 'Cornish Gilliflower,' both varieties of good quality, are typical examples.

Most of the foregoing observations apply to apples and pears. Apples and pears are very much alike in their requirements as regards pruning, except that pears generally stand harder pruning with the exception of the variety 'Jargonelle.'

The upright habit of the majority of pear trees produces shapely specimens when grown in all forms, which tends to make the operation of pruning easier than it is in some other kinds of fruit trees.

The pruning of the plum differs considerably from that of the apple and pear after the initial formation of the tree. In the plum grown as bush or standard, spur pruning should not be attempted in any form, as, once the tree is shaped, little or no pruning is necessary beyond occasionally shortening a leader and removing crossing branches, taking care that the pruning is done in October before the leaves have fallen. The pruning cut should be clean and coated with paint or a similar preparation. Plums should be induced to form fruit spurs naturally. This can be attained by the correct pruning of the leaders and manurial treatment. A proper balance between root and branches is most essential in the plum. A fan-trained plum tree is even more difficult to manage, and only by correct cultural treatment can one hope to be successful with plums grown in this form.

Here again, as far as possible, the tree should be encouraged to form fruit spurs naturally, and as little cutting as possible should be done, relying more upon the pinching of the green shoots. To those in doubt as to the correct method of pruning plums, my advice is to leave the trees entirely alone beyond cutting out dead and diseased wood.

The question of pruning in the season of planting is a vexed one, and much has been argued for and against, but no doubt the consensus of opinion is in favour of pruning the same winter as planting takes place. If the young trees are planted in early autumn the pruning can be carried out well before growth becomes active, whereas, on the other hand, if planting is late it is advisable to delay pruning so that the tree has as much time as possible for root growth to take place prior to pruning.

Although pruning can be done with safety in October before the leaves fall the time to carry out winter or dormant pruning of apples and pears is any time during autumn and winter. A start is usually made as soon as the leaves have fallen, and pears are usually first in this respect. The aim should be to complete the operation by Christmas if possible. As already mentioned, plums should be pruned before the leaves have fallen, and July or August is really the best time. Early July should see all dead or diseased branches removed. If for some reason pruning has been delayed, it can be done with safety as long as the trees are dormant, but it is advisable to complete this operation by the New Year, then the trees are ready for their seasonal spraying, and where the trees are growing in cultivated ground tillage can be completed in good time.

Branch Pruning.—This operation becomes necessary in the case of dead or diseased branches or where trees have reached maturity.

It might be said, Why allow surplus branches to form ? but sometimes this is necessary where a tree is exceptionally vigorous in its youth, but their removal can be carried out judiciously once the tree has expended its excessive energy.

When cutting away a branch, always take care that the cut is clean and as close as possible to the part from which it is cut. If a long snag is left, this will ultimately die back and affect the part from which it originated. Callusing is aided if the cut surface is pared with a clean knife, and the wound should be coated with lead paint or tar to prevent bacteria or spores of fungi from entering.

Spur Pruning.—After the apple and pear have reached maturity, and fruit spurs become weak and elongated, it is an advantage to remove some, especially in pears, and some of the free-fruiting apples. In some instances spurs can be removed entirely, and in others they can be shortened. This will result in renewed vigour being imparted to the spurs that remain, as it is not necessary to have a great number of these to obtain a good crop of fruit.

An over-abundance of fruit spurs often means weak flowers, and consequently little or no fruit, whereas if the number is reduced, the remainder are vigorous and ample for the production of a full crop of fruit.

The question of knife or secateurs for pruning is a debatable one, but much depends upon the kind of knife or secateurs, and the person using them. A good sharp knife in the hands of a capable person is undoubtably the best instrument, but unfortunately there are very few persons who can use a knife skilfully. There is very little harm in using good sharp secateurs on apples and pears for ordinary pruning, but it is much better to use a knife on stone fruits.

When pruning a tree do as much as possible from one position, thereby saving useless trampling, especially on soils which are not improved by constant treading, and much time is saved.

One of the best aids in the study of pruning is to make a close examination of the fruit tree when dormant. Much can be learned by this, and it is perhaps no exaggeration to say that the tree at that period could almost tell you the treatment it requires.

No one can be successful in the art of pruning who does not understand the make up of a fruit tree. By following each year's growth from the previous year backwards, it is possible to see how fruit buds and spurs are formed.

In conclusion, too much stress cannot be laid upon the necessity for keen observation to become a successful pruner, noting the result of previous treatment, and if such has not been successful, modifying it whichever direction seems reasonable.

Above all, prune with your head as well as your hands.

SUMMER PRUNING OF HARD FRUITS.

By A. H. Lees, M.A.

The subject of pruning fruit trees in general has always aroused considerable discussion and argument. Anyone entering such dangerous waters is likely to meet stormy weather, the storm being nearly as violent as those provoked by politics and religion. Since this is so, and much of the argument is often at cross purposes owing to the different meanings the disputants apply to the same words, I think it is best to endeavour to clear the air somewhat before a start is made with the subject proper. I propose, therefore, to deal with the subject under three main divisions. These will be (1) the range of conditions in which summer pruning is effective, (2) the object to be attained, and (3) the methods employed.

It is a pity, I think, that the range of effective pruning is not more emphasized by writers on the subject. Considerable disappointment might be saved for the operator, and his work would be far more successful. Apple and pear trees vary a great deal in vegetative vigour. By vegetative vigour I mean those internal conditions which cause the trees to produce strong vegetative growth. Though this is essentially a characteristic of youth, it is not confined to young trees nor is it an essential of young trees. Though usually vigorous, young trees may be checked, just as old trees, though usually checked, may be vigorous. It is a function of internal conditions rather than of age.

Now pruning in general and summer pruning in particular is only effective within a certain range of vegetative vigour. If, for instance, the tree is so checked that no shoots are produced, it is obvious that there is nothing to prune. If, on the other hand, vegetative vigour is extremely great, the tendency to form shoots is so strong that pruning merely increases the tendency, and nothing in the direction of flower production can be secured. It is necessary, therefore, to ensure the plant being somewhere in the prunable range. This can be attained both by general and by special methods. At the lower end of the scale, where the tree is too weak to grow, much can be done by hard heading back in the winter, coupled with high manuring. At the higher end, where growth is too strong, cover cropping, ringing and withholding of manure will bring the tree into prunable range. But besides these facts, doubtless known to you all, there is a special condition not generally referred to except in passing, but which has a very important bearing on successful summer pruning. The vegetative vigour of a tree increases from the beginning of May, attains a maximum sometime late in June, and then decreases through July till at the end of August it is almost nothing. The reaction a pruner

gets when cutting a shoot will therefore depend not only on the general vigour of the tree, but on the exact position it has attained in the summer cycle. If pruned too early fresh shoots are produced, if too late, no visible effect is produced, while somewhere in between lies the desirable mean.

I hope I have made it clear in the above argument that the range of pruning is a most important factor. Many failures in pruning apples and pears are due to the fact that the tree is in the wrong condition, rather than that the pruning system is at fault.

Objects of Summer Pruning.—Upon the success attending the attainment of the objects of pruning will a system be judged. It is therefore a matter of great importance to define clearly what the objects to be obtained are.

They are (*a*) the effect on the incipient spur, (*b*) the effect on training the young tree and (*c*) the effect on the fruit. Of these, the aid summer pruning gives to spur formation is perhaps the most important, especially in young trees. Upon the success or otherwise in this direction must every system of summer pruning be very largely judged. In the present conditions, when many new growers are starting, with often limited capital, an early production of flowers and fruit is of the first importance.

At the same time summer pruning can be used for the training of the main structure of the tree. Every shoot that is not required for extension growth is pruned, thus forcing extra strength into the desired leaders. Lastly, summer pruning should have an effect on the fruit. It should, by reason of the increased light let into the tree, increase the colour of the fruit and also, owing to removal of a large surface of leafage, the size of the fruit.

Methods.—Whilst there are no doubt many and divers methods used during the long time during which men have been interested in the cultivation of apples and pears, I propose to treat only two systems, namely, what one may call the old standard system on the one hand, and the Lorette system and *modified Lorette system on the other.

The essential process of the " standard system " was the shortening of unwanted laterals, leaving a shoot with 4–6 leaves (not counting the small leaves at the base). This shortening was done from the end of July in early varieties to the middle of August in late ones. On the whole, however, the second week in August was the usual time. This, if done consistently, resulted in all shoots not wanted for leader extension being shortened. The following winter such shoots were either further shortened or left as they were. Pears were treated in a similar way but the operation was begun three weeks earlier. While admitting that this method secures advantages in extra light to the interior of the tree and also increases the size and colour of the fruit,

* Some criticism has been expressed against the use of the word " Lorette " in describing this method. The writer, whose system it is, merely wished to express his debt to M. Lorette. He is, however, quite willing to father it himself.

considerable criticism may be directed against it when the point of view of spur formation is examined.

First, from the point of view of the time of application. By the middle of August the vegetative vigour has dropped considerably. The reaction of buds to a pruning cut is consequently very low, and it often happens that nothing more occurs than a slight plumping up of the bud immediately below the cut.

Secondly, from the point of view of obtaining spurs close to the scaffold branches. If in winter these summer-treated shoots are left untouched, the shoot will tend to lengthen the following year and flower buds, if and when they are finally produced, will be a long way from the scaffold branches. If, on the other hand, the summer-treated shoots are shortened in winter (say according to the three-bud system) all one's summer work is wasted. It is wasted for this reason. Even in the most vigorous bushes not more than two buds react or are influenced behind the pruning cut. If, therefore, in winter all the influenced buds are removed and only uninfluenced buds left, one might as well have omitted the summer process altogether.

The Lorette system was invented and carried out by a Frenchman of that name and formed the subject of considerable controversy in his own country. He described his methods in a book called "La Taille Lorette." The second edition, which first appeared in England, afforded the reader many new ideas but demanded the exercise of considerable patience and ingenuity in discovering them. As one of his French critics put it "M. LORETTE is mightier with the secateurs than with the pen!" The third edition, translated by DYKES seems to me to be less informative. The second edition then was my guide for my first trials in his methods, and if I do not do them justice in the eyes of some who have made personal contact with M. LORETTE this must be my excuse.

In describing pruning operations, especially without the aid of illustrations, it is easy to get into a muddle. I therefore propose to start with the simplest cases and to work on to the more complicated ones. I shall therefore choose two starting points (1) the simple shoot of summer growth, arising directly from a main branch, and (2) the flower. From these points I propose to trace their subsequent treatment and history.

The summer shoot (arising direct from a main branch) is treated about July 20 in an apple, and three weeks earlier for a pear. It may be remarked that while vegetative vigour is greater at this time of the year than in August, the buds left after pruning are considerably weaker than in the standard method. The criterion usually given is that it should be semi-woody, about pencil thickness, and usually about ten inches long.

It is then cut hard back to the basal cluster of leaves (if present), otherwise at any rate to ¼ to ⅜ inches. The result of this according to LORETTE is that stipulary eyes are stimulated. Here it must be remembered that LORETTE worked mainly on pears. He contended

that stipulary eyes, being weaker, turned into flower buds more easily. In practice at least three different reactions are possible.

(1) No stimulation of stipulary buds takes place. Nor do axillary buds grow, and the pruner at winter time is presented with the depressing spectacle of rows of bare, dead stumps. This reaction was very frequent at Long Ashton in pears, and led the present writer to modify the method.

(2) The stipulary eyes are forced out into long shoots, are "cut to heel" again when fit, usually about three to four weeks after the first cut. If shoots of a third series grow they are again cut late in August. Finally there is left nothing but a series of dards which, in the course of time, become flower buds.

(3) The stipulary eyes become dards straight away, and in due course, flowers.

I have hardly ever been able to obtain stipulary eyes in the case of apples, and in my opinion the method as applied to apples for spur production leaves a great deal to be desired.

There is one type of simple summer shoot that is an exception to the above treatment, and that is the thin twiggy shoot with a terminal cluster of leaves, called a "brindille." In the case of tip bearers it may be left, otherwise pruned to three eyes.

The Flower Bud.—Having attained flower bud, the next question that arises is how to treat their further growth when the flower (which is really an inflorescence) opens. The individual flowers are borne on a thickened structure called the bourse or knob, and whether the flowers form fruits or not this structure thickens and becomes somewhat woody and bears laterally and nearly opposite each other two small buds, the bourse buds. It is on the behaviour of these that the future flowering of an old tree depends. The possibilities to be envisaged are as follows:

(1) No bourse buds appear. This is an extremely weak and unusual condition.

(2) One only (the higher one) appears.

(3) Both are present.

One or both may grow out into woodshoots. Provided one appears but does not grow out, no action is called for in summer. If, however, shoots appear on the bourse they should be pruned hard to half an inch about a fortnight before the first summer shoot pruning. They can, however, be left till the usual time without much being lost. This action usually strengthens the second bourse bud if present, or forces some bud below the bourse if only one bourse bud is there. In any case dards form, which finally give rise to flower buds.

As the spur increases with age, there will be found many bourses on the structure and many bourse shoots. It is then advisable to leave one shoot uncut to act as a sap drawer, otherwise dards may be forced into growth that had better remain quiescent. Considerable latitude should be left to the operator in the treatment of shoots from compound spurs. The principle underlying successful treatment is to stimulate the buds behind the cut into plumping up without forcing

them into wood growth. This may be achieved sometimes by leaving one shoot with one or two buds on, or two shoots ditto, or none according to conditions. Thus a sap drawer or gentle pruning is indicated when the vegetative vigour is great, the variety strong, or the position of the spur strong (*e.g.* just behind a winter prune). All these are niceties, and cannot be very well confined in hard-and-fast words, but must be left to the discretion and even more to the experience of the operator. The above roughly describes the general processes employed by LORETTE for the production of spurs. Those who require further and more intricate details should consult his book, as the writer realizes that this description does not do justice to his very detailed directions.

The pure doctrine of Lorettism enjoins three summer prunings. Now it may quite possibly amuse the amateur to perform all three and to spend his time pottering about his few trees. But he will, if of a thinking and arithmetical turn of mind, discover that the total amount of time spent on each tree is astonishingly high. If his mind goes further and he calculates the time he would spend on an acre and the money it would cost if he were paid 10*d.* to 1*s.* an hour, he would begin to wonder whether it would pay its way on a commercial scale. Then again, unfortunately, the hard cutting enjoined by LORETTE seemed to produce a terrible number of dead stumps even on pears, while on apples the results were even worse when carried out by the writer at Long Ashton. It seemed to him, therefore, that for his conditions some modifications were necessary. The first and most obvious was the reduction of the number of operations. The first cut seemed to produce about 90 per cent. of the total effect, and September operations were just as effective if done in winter. On the large scale, therefore, only one operation was performed, for pears round about June 30 and for apples round about July 20. This reduced the cost considerably, and secured practically all the good possible from the operation. The second modification was made necessary by the unsatisfactory reaction caused by the hard Lorette cut. As above described, this frequently resulted in a dead stump and not infrequently in the outgrowth of a sappy shoot. Only rarely did a good development of the stipulary eye occur.

The modification selected was a cut to two good eyes instead of to the basal cluster. A "good" eye is one that is distinctly visible at the time of pruning. It usually means leaving a length of two to two and a half inches.

The advantage of this operation is that one gets the best of both worlds. The flower buds, when at last obtained, are still quite close to the scaffold branch, while the two buds left give three possible types of reaction. Thus:

(1) Neither bud grows out, but both are plumped up.
(2) Number one bud grows out and number two is plumped up.
(3) Both grow out.

It might be argued that three buds would give even more chances, but there are two objections. First the final spur would be farther

from the supporting branch, and secondly, it is only rarely that more than two buds are influenced by a summer prune. There is therefore no object in pruning longer than two buds except in cases of exceptional strength.

Let us start as before from the simple summer shoot arising directly from a main branch. It is pruned to two buds. If neither grows out nothing need be done next winter and one or both will go over into flower buds. If No. 1 grows out but No. 2 does not, then in winter *the* No. *1 shoot* is pruned to two buds, thus, with the No. 2 bud, already present, being pruned according to the three-bud system. Next summer we have the original No. 2 (now No. 3) changing into a dard or flower bud, a fresh growth from the new No. 1 bud of the winter prune, and an incipient dard from the new No. 2 bud of the winter prune. This time the new No. 1, in the double system, is not pruned to two eyes, because there are already two good buds, probably dards, behind it. It is from one or both of these dards (Nos. 2 or 3) that we are looking to form a flower bud. They must neither be starved nor forced out. If No. 1 were cut right out they would be forced out ; if No. 1 is cut to two buds (remembering always that the summer prune influence only goes to two buds) Nos. 3 and 4 might be starved. So the proper cut is to one bud. As the years go by these structures get more complicated. They then often contain several dards and several shoots but no flowers, if weather conditions or internal conditions have been unfavourable. In that case some of the shoots may be cut back behind visible eyes, one or two only being left, and cut to one bud. These niceties have to be learned in the field and cannot be explained on paper.

In the third case where both summer-pruned buds grow out, nothing is done till the winter when the three-bud system leaves one bud on No. 1 shoot and two on No. 2 shoot. The subsequent history is as explained above.

Sooner or later flower buds are formed, and it is to this stage that attention must now be directed. As explained, when describing the pure Lorette system, two buds are typically present on the bourse. The history of these is slightly different from the two buds on a simple summer shoot. For one thing it is important that these spurs should not elongate too much, and so grown-out bourse buds are cut hard to the heel. When a fruit is developing the hard cut seldom makes the second bourse bud grow out, and where there is no fruit there are nearly always present weak buds on the small stalk bearing the bourse that can be turned into dards. The rule for pruning bourse shoots on a simple spur is therefore to prune them hard to the base. When the spur, after a year or two, becomes a spur system, and is covered with incipient fruit buds, dards and shoots, a rather less drastic prune is advisable. In that case one or more shoots are cut to one eye so as to act as sap drawers. The exact amount of sap drawers left will depend on the development of the buds behind. The rule, however, is—the stronger the buds behind the more sap drawers are left ;

developing dards must be stimulated slightly but not forced out. Such is this modified Lorette system. Briefly its advantages are that, entailing only one operation in summer, it is possible to use it commercially, and, secondly, as it does not depend on the production of stipulary eyes but works on those already present, the chances of success are much greater.

I cannot close this paper without some reference to the question as to whether summer pruning for hard fruits is worth while. As regards the standard system of summer pruning, I admit that the operation helps the fruit as regards colour and, possibly, as regards size, but I doubt very much whether it has any influence on spur formation. Either the Lorette or modified Lorette system certainly helps in spur formation and has a marked effect in limiting excessive growth in a tree, a condition from which amateurs' trees often suffer. Once or twice at our farm certain rows of trees were missed from summer pruning, and where this happened two years running the trees became almost unmanageable. For any intensive system of growing apples or pears, therefore, this kind of summer pruning is of the greatest service. It is very effective in letting light into the tree, and so helping colour, but it also has a quite noticeable effect on size. These are the advantages: now what is the cost? In our system of cultivation where we grow dwarf pyramids close together, two people working together, one on each side of the tree, can do an acre in 40 man-hours. The cost, therefore, would be about £2. For a fully developed bush plantation the cost might be more, owing to the difficulty of reaching high shoots but those who insist on growing tall forms of trees must suffer certain disadvantages.

Two pounds sterling represents 80 lb. of *6d.* a lb. apples, 120 lb. of *4d.* a lb. apples and 240 lb. of *2d.* a lb. apples. Now any good grower should be able to average four tons an acre of a prolific *2d.* a lb. apple. Two hundredweights increase, which the cost of summer pruning demands, represents, therefore, only an increase of 2½ per cent. In my opinion, continuous cropping in trees that have not attained their full size, and this means a period about fifteen years for a bush tree, cannot be secured without the assistance of summer pruning.

I may now sum up finally the advantages of this modified Lorette system.

(*a*) It aids the formation of flower spurs.

(*b*) It shapes a young tree.

(*c*) It increases the size and colour of the fruit.

(*d*) It is an essential for the control of closely planted trees in intensive systems.

(*e*) It is essential for the production of continuous crops in young trees and a great aid for the same object in old trees.

FIG. 1.—APPLE 'BLUE PEARMAIN.'
Lorette pruned (Mr. Bostock).

[*To face p.* 20.

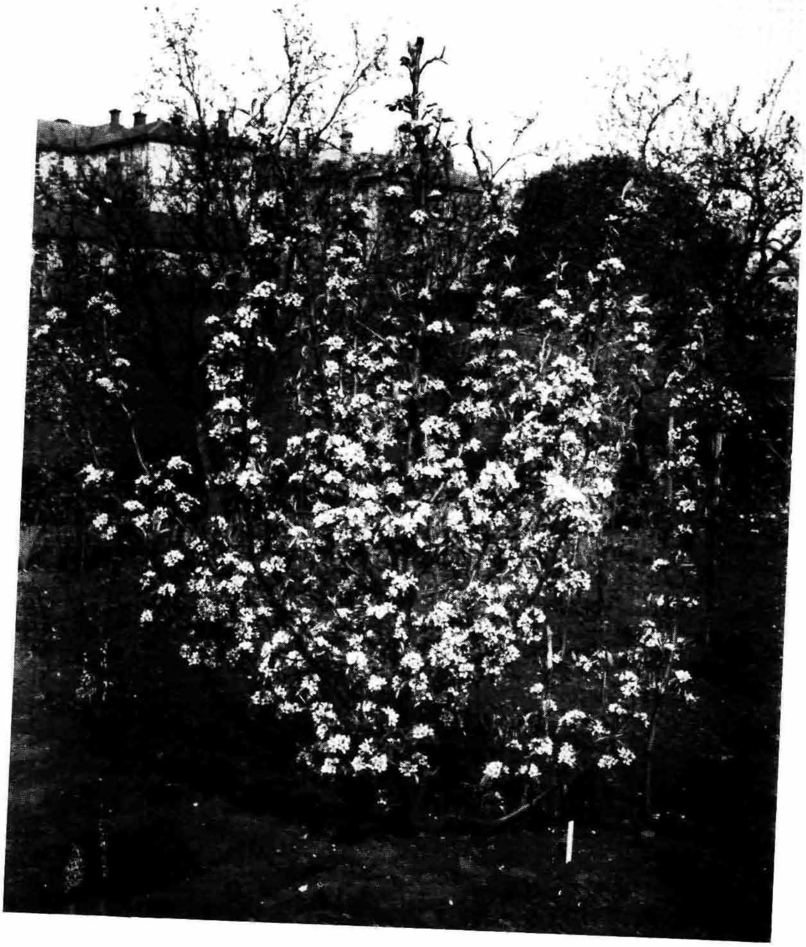

FIG. 2.—PEAR 'THOMPSON'S.'
Lorette pruned (Mr. Bostock).

Discussion.

Mr. F. Bostock : I presume I have been asked to take part in this discussion on pruning because I have practised for a long time La Taille Lorette. We have, however, also taking part in the discussion the greatest exponent and expert of this system, namely, Dr. Herbert Durham, who knows more about it than anyone in this country and of whom I am only a disciple. I am entirely indebted to him for introducing me to La Taille Lorette. I shall therefore confine myself briefly to a few personal and general remarks on the subject.

I do not think it is too fanciful to state that Nature was the first pruner in the form of injured and broken branches, etc. Man has studied the results and based his methods of pruning on them for the purpose of rendering fruit trees productive of fruit. It follows, therefore, there must be many schools of pruning, all aimed in the same direction and most of them more or less successful.

I should be the last person to claim that the Lorette system is the best. All I can say is that with me it has been very successful and I am satisfied with it. I carry it out in its entirety with no modifications. My orchard consists of some 200 trees which were planted in my present garden in 1925. I, however, started Lorette pruning in another garden in 1915, where I had very good results. All the pruning is done by myself.

I claim that with this method you obtain complete control of tree-growth with abundant production of fruit buds close to the main branches, thus avoiding the loss of fruit through friction from the wind, and gain a high quality of fruit.

Briefly stated the periods of pruning are about as follows :—

(1) Extensions shortened early in April.
(2) Lorette pruning of shoots about second week in June for pears, and end of June or first week in July for apples.
(3) General look over and pruning as per Lorette's instructions, first week in September.

The result is that trees are open and clear after September and during the winter. There is no forest of shoots, but all is in order and it is a pleasure to walk round the garden and view your trees in the winter.

Here I would like to say that anyone who wishes to take up this Lorette method should study it in the original. My copy is the Second Edition, published in 1914 and obtained from :—

Laboratoires Georges Truffaut,
90 bis, Avenue de Paris, 90 bis,
Versailles.

The book is not quite as clear as it might be, and requires careful study. I think this accounts for many inaccuracies which have crept into the Press from time to time in describing the Lorette method.

As you are aware the first pruning is to the basal cluster, or group of folioles. If you examine your trees, both pears and apples, in the winter, you will find what is equivalent to a false bourse where the shoot has been pruned. You will also find that a little cap of disintegrated wood has been formed which can be pushed off with the finger, leaving a scar or corky surface which is more or less equivalent to that left on a fruit knob or bourse. The resemblance to the latter is remarkable and I have always called this a false bourse or knob, and in effect that is what it is. Your tree, therefore, is not only furnished with natural knobs, but also artificial knobs of a similar character.

There is one point about this pruning which I think should recommend itself to most amateurs, namely, that it is carried out at the pleasant time of the year and not in cold weather.

Finally, I should like to say that after all there is nothing absolutely new about Lorette theories. In an old book lent to me by Mr. BUNYARD, *viz.* "The Art of Pruning Fruit Trees," by Dr. NICHOLAS VENETTE, 1633–98, you will find this early May–June pruning adopted more or less, and to come down to later times in "The Clergyman's Recreation," by JOHN LAWRENCE, 1726, the following instructions appear in the May Calendar :—

> "Now begin the summer pruning of pears, cutting off the shoots of this year that come forward, to ½ inch."

Again in July you are advised to go over the tree again :—

> "The pear tree is now to be minded and disciplined too ; if over vigorous, cutting off all branches that push forward to ½ inch."

Summer pruning, I am convinced, is often done a little too late in August. At that time the sap is running very slowly, and I suggest that the first week in August is the very latest date for summer pruning and it would be preferably done end of July.

In Mr. LEES' remarks and criticism *re* summer shoots shortened in winter, he appears to have overlooked the stipulary eyes which exist at the base of the shoot, and only refers to the three-bud system.

I agree with his criticisms *re* Mr. LORETTE'S book, 2nd Edition. *Nevertheless I strongly advise those intending to experiment with* Lorette pruning to study the original rather than the English translation by Mr. DYKES.

Mention is made in Mr. LEES' paper about the shoot being of "pencil thickness." This, I think, is misleading, because the French pencils are generally thinner than the usual English pencil. This reference is better left out, and one should rather rely on one's judgment as to whether the shoot is sufficiently ligneous or semi-woody.

With regard to the reaction No. 1, *viz.* rows of bare sticks, this is

not my experience, at any rate not to any serious amount, and I suggest that the pruning was done too soon.

No. 2 reaction: there seems to be a bit of a mix-up. Lorette does not refer to stipulary eyes being forced out into long shoots, but the actual second growth on the pruned shoot rising from the top leaf where the pruning is not done to the basal cluster.

With regard to apples, whilst I agree that it has not been quite so satisfactory as for pears, it is only in a few instances, and speaking generally my apples answer well to Lorette pruning.

I have seen very few dead stumps on my pears and where they occur I have always put it down to too early pruning.

I should like to say finally, that I have no intention of adopting so-called modified Lorette pruning, but intend to stick to Lorette's method as I interpret it without any modifications.

Turning now to Mr. WILSON's remarks on the Winter Pruning of Apples and Pears, whilst advice is given how to treat them during the formation of the tree, nothing is said as to the treatment when the tree is formed. Lorette's treatment is to cut right back in April, which results in three or four shoots arising. When these are of sufficient length one is left and the rest are cut right back.

I fail to see how winter pruning really controls the activities of the tree, seeing that the pruning is done when there is no movement in the sap. The contrary is true with regard to Lorette and summer puning, if done in time. It seems to me there can be no control if there is no activity.

This point is touched upon in Mr. A. H. LEES' paper on Summer Pruning.

Dr. H. E. DURHAM: If one is riding homeward along a lane, with occasional branch lanes or gates into fields, and casts the reins upon the horse's neck, the horse will proceed the way he knows, perhaps with a sniff at one or other side issue, on to the end of the lane. That I would liken to winter pruning.

If, however, you retain the reins and are adept with the hunting crop, you can guide him aside, whither you list, instead of going straight ahead. That I should liken to leaf-time pruning, which is a better and more explicit term than summer pruning.

Whilst the leaves are drawing sap, we have some power of directing its flow, either by impeding it or by encouraging it to go along certain paths. Voluntary control of sap-flow is the basis of leaf-time pruning; but there must be sap-flow and a sufficiency of it for the immediate purpose.

Perhaps one of the simplest illustrations is presented by LORETTE's treatment for the peach tree; about the axils of the leaves are three eyes: normally the two side ones will produce blossoms in the next season, the middle one only a wood-shoot. If too much sap reaches the middle eye, it will grow prematurely into a wood-shoot and, should this happen, the blossom-buds are starved and lie undeveloped, so no fruit results. By checking the sap drawn up by the actions of the

leaves, the sap-flow may be checked, the premature growth of the wood-shoot may likewise be checked. This is simply done by snipping off some $\frac{1}{3}$ or $\frac{1}{2}$ of the pertaining leaves.

On the other hand, it may be advisable to encourage the flow of sap, as in the formation of the stem of a standard tree. As the stem grows, side-shoots appear, the stem becomes "feathered," these help to draw sap into the stem and to empower its growth. But if these side-shoots are allowed too much scope, some may become too greedy and take sap which would be better utilized at the head. A gradual and judicious pinching of these shoots from below upwards, only finally removing them when they are judged to have done sufficient work, is a valuable aid to trunk formation. Such a procedure can only be performed during leaf-time.

Again, as another instance, a leading or upwardly directed shoot, if left to itself, tends to become bare in its lower parts, the sap rises to the top where growth continues, the lower leaves fall off and their eyes remain dormant—eventually a length of "bare pole" results. Permanently dormant eyes can hardly be regarded as great producers as such, and to make them produce we must make them grow. The matter can be dealt with at a winter pruning, when, if the growth and the shortening be not commensurate, we may still have a few potentially useful eyes remaining closed and again an interval of bare pole may result. If, however, growth is checked in July or some time before the normal slackening of sap-flow (shown by the definitive formation of the terminal eye), the otherwise dormant buds are given extra nourishment and thus may be made to sprout next season. Where with a winter shortening only some seven or eight eyes can be left without risk of some remaining dormant, after such leaf-time interference some dozen or more may be safely left. Furthermore, good hearty eyes are useful for grafts and budding buds; a summer shortening of the shoots is a well-known device for obtaining them.

Here I may deplore the habit of some writers of using the word "tipping" for a removal of some $\frac{1}{4}$–$\frac{1}{2}$ the length of a shoot: tipping properly does not amount to more than a mere pinching of the tip, probably in the green state.

Eyes and Buds.—The prime material for the pruner is afforded by the nascent points of growth—the eyes and the buds, and here we may give some consideration of these organs especially in so far as the apple and pear are concerned. Some years ago, in connexion with an appeal to get a nomenclature for tree-parts in our language—until such be established it seems pretty hopeless to give a clear account of actual pruning ways—I suggested that for clarity the word "eye" should be reserved for the primitive undifferentiated organ, whilst "bud" should be applied where a blossoming or fruiting organ is involved (wood-eyes and fruit-buds; *cf.* the French often make distinction of *yeux* and *boutons*).

Various kinds of eye are distinguished—the main or axillary, the terminal, the stipulary, the dormant or latent, and the adventitious.

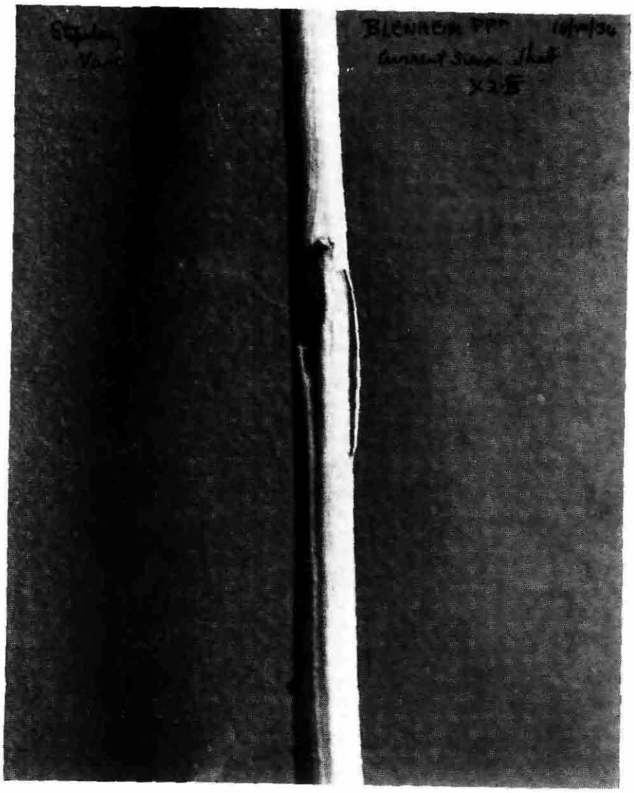

FIG. 3.—APPLE.

Season's shoot peeled : note bud seat *below which woody fibres* lead to stipulary eyes.

[*To face p.* 24.

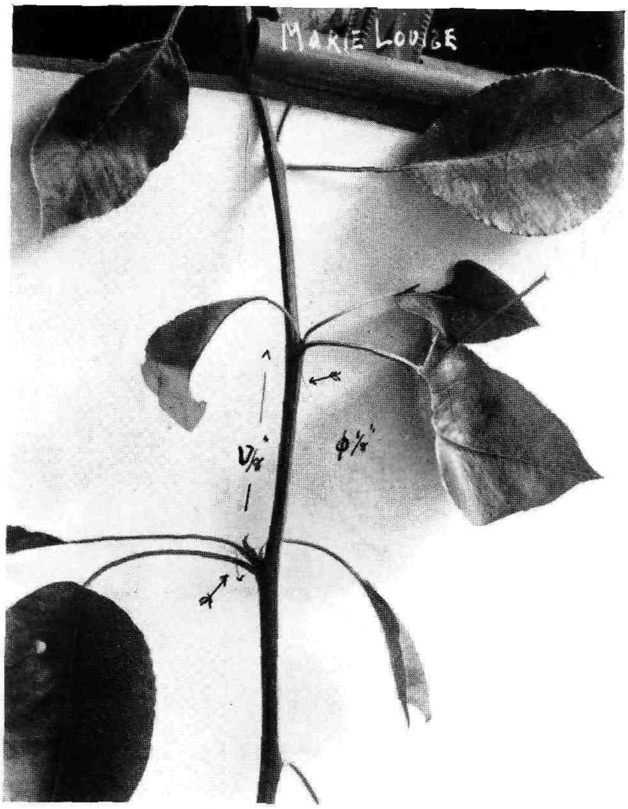

FIG. 4.—PEAR.

Season's shoot. Above, paired leaves seated close to axil; below, paired leaves from premature growth of main bud.

FIG. 5.—PEAR PRUNING.

Long wrinkled-bark dard. Note slow growth, wrinkled bark on left, numerous bud seats on peeled portion. The upper part would show only the main and stipulary buds.

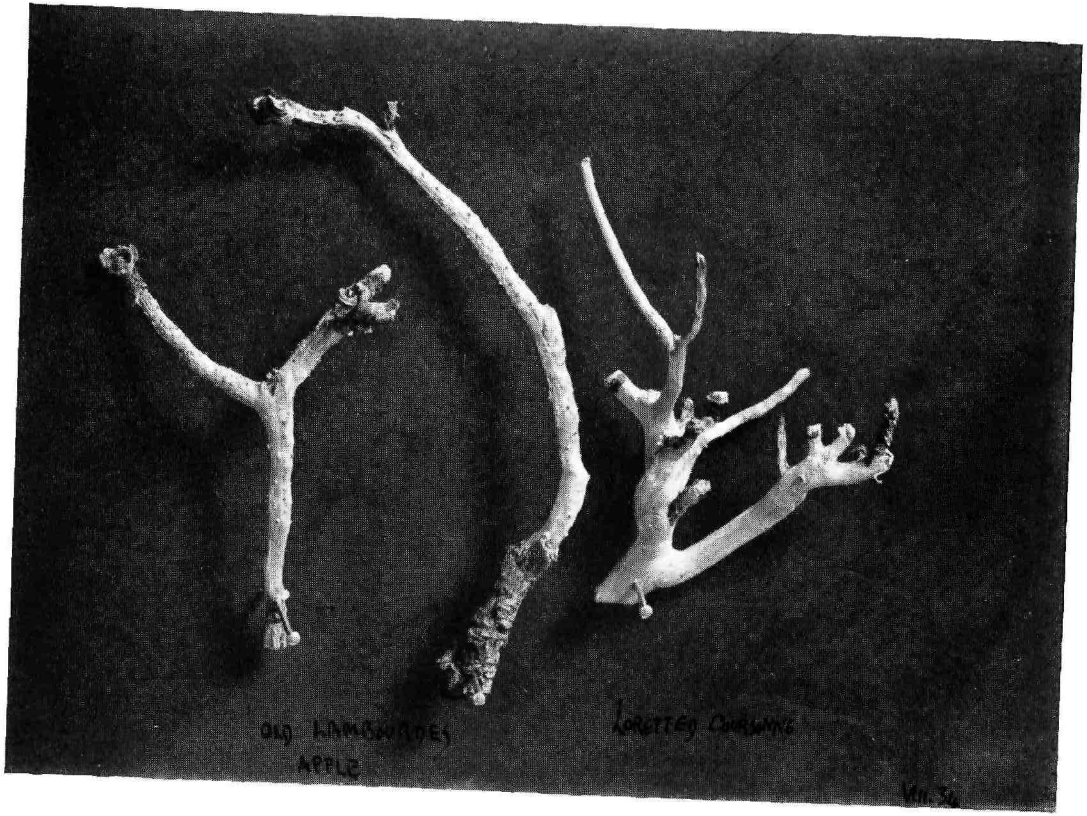

FIG. 6.—APPLE PRUNING.

Left, two old spurs peeled showing numerous bud seats. Right, branchlet repeatedly pruned according to Lorette's method. Bud seats not visible, but obscured by woody growth.

[To face p. 25.

Such are the working materials of the pruner, and it is his job to make such use of them as he may desire. The *Terminal Eye* is usually undifferentiated and may produce wood-growth or blossom; it becomes established when the growth of the season has slackened. The *Main Eyes* on the season's shoot, situate at the axils of the leaves, are often called "axillary"—a term which is perhaps best avoided from its mock resemblance to auxiliary; unfortunately the French call them "lateral" (*yeux latéraux*), presumably since they give origin to lateral growths or shoots. Towards the base of the shoot they become less and less prominent—that is, they are less developed and more liable to remain without further development, a circumstance which is enhanced by the frequent earlier drop of their leaves than is the case farther up the shoot. With a sufficiently abundant flow of sap they tend to produce wood-shoots, but when the flow is sufficiently moderate, but enough to awaken them, they will produce blossom-buds. Associated with their less complete apparent development they have fewer and less-developed nutrient vessels, so that their facilities for getting sap are handicapped; hence they have more opportunity of becoming blossom-buds. It is during the period of growth that the pruner has most power of directing sap into them.

Stipulary Eyes.—On either side of the main shoot eyes exist, paired eyes which normally remain latent; thus at each leaf there are three eyes, not one single eye. According to RIVIÈRE (*Traité d'arboriculture fruitière*, 1928, p. 29) these stipulary eyes were first described by AUBERT DU PETIT THOUARS (1806–15); apparently they were thought to be connected with the stipules (the more or less leaf-like organs attached about the bases of the leaf-stalks). Attention was again called to them by DU BREUIL (*e.g.* 2nd Edition, 1857, p. 56), who claimed that the shoots arising from them were much more disposed to produce fruiting organs than those direct from the main-shoot eye. He evoked them by shortening or pinching the main shoot, and when evoked it was the second or later appearing stipulary shoot that was preserved. Later LORETTE followed and elaborated somewhat on his predecessor. RIVIÈRE states categorically that stipulary eyes in apple and pear only produce wood-shoots in their first development; we shall see later that it is difficult to follow quite so dogmatically, though his dictum is not improbable. The name "stipulary" is unfortunate in its essence, as these buds have naught to do with the leaf stipules; but it is so distinctive and now so popularized that it is perhaps best to retain it. After all primitive error remains stamped on such words as oxygen = the acid producer, though numerous acids, we know, contain none of it; or again, "azote" the lifeless, though nitrogen is a prime need of all living things. Usually these stipulary eyes are not discerned by the naked eye, statements of some writers notwithstanding. But their existence is easily demonstrated by peeling the bark from a fresh shoot (best from below upwards), then a stump of woody matter will be seen proceeding from the main eye itself; below this is another stump left by the rupture of the fibres

passing to the leaf-stalk. On either side, somewhat lower down than the woody stumps already mentioned, and themselves usually also at different levels, will be seen the fibrous bundles belonging to the stipulary eyes. Generally their woody development is incomplete towards their ends and unequal as regards one another, so that usually they are torn off below the level of the eyes themselves. Sometimes, on young and also on older wood in apple or pear and more regularly in quince and medlar, they reach up to their full level. By means of dissociating agents, such as cupri-ammonia solutions, they can oft be demonstrated to higher levels in apple and pear, but even then it appears that incomplete lignification has been reached. The one which has greatest lignification is obviously that which will be the first to appear when they are evoked from dormancy. The prominent little ridges of woody fibre generally become indistinct in the second and later years through growth of the main wood of the shoot in which they become confusedly embedded.

Sometimes in apple, and more commonly in pear, a pair of little leaves (folioles) are to be seen at the axil of a leaf—sometimes without and sometimes with some insect injury to the related leaf. These have been described as the leaves belonging to the stipulary eyes; however, the specimens or photographs which are exhibited show that these little leaves are products of the main eye and have nothing whatever to do with the stipulary eyes. Occasionally, as will be seen, there are three such little leaves, which also is opposed to any connexion with the stipularies. RIVIÈRE alleges that more than a single pair may occur in the Plum tribe: probably these are further developments which give rise to the well-known "bouquets de Mai."

The utilization of these stipulary eyes for obtaining even forkings and for making main stems has been made known especially by LORETTE. (JOURNAL R.H.S., **43**, figs. 38, 39 and 40.)

Other Latent or Dormant Eyes.—Having dealt with the demonstrably peculiar "stipulary" eyes, if we continue peeling off bark from a shoot and pass upwards from older wood to the new growth, we shall find that there are numerous bud-seats, evidenced by the tiny woody projections that are left; these are assembled about the commencement of the new wood. If we select an old fruiting spur and peel it we shall find a great abundance of these little bud-seats; here there is much advantage in a maceration in the cupric solution, for the bark is often dry and will not separate easily otherwise. How do these bud-seats arise? Is each little bud-source situate at the axil of some long-departed leaf? Botanical anatomists do not help us here with microscope researches, for it seems that there are yet untrodden paths of enquiry and research. Again, given that they have a leaf axil origin, does each of our supposed leaves generate single or triplicate eyes—only main eyes or main eyes with pairs of stipularies as on the more distal part of the shoot? At the bases of the new growth some thirteen to sixteen or more eye-sources may be counted. It is well known that basal clusters of leaves occur at bases of vigorous continuation

shoots, as also on hearty side shoots; these when six to eight in number would provide in triplicate eighteen to twenty-four eye-sources. But we may suppose that only those eye-sources which have reached a certain development will be capable of leaving signs of their presence to naked eye observation ; microscopical sections might be needed to reveal such rudimentary germs.

Now let us turn to a weaker growth—say a smooth-barked long dard ; in its first inch it has but one or two leaves, yet we can count many eye-sources. How can we account for these ? Botanists tell us that the green leaves we see are not the only leaves on the tree, for the protecting scales of the eyes or buds are also of the nature of leaves, modified for their special purpose. It is not impossible that such " leaves " also have associated eyes. When the growth has been still more checked in length as in old spurs or lambourdes and the bark is much ridged and grooved from the scars of leaves and scales we find very numerous eye-sources on peeling away the bark. Here it is quite impossible to recognize any definite triplicate arrangement. The favour with which some growers regard the pruning in wrinkled bark (*taille sùr rides*) is well known and leads to an awakening of some few growths, generally near the cut end. Where in the past a bourse has been formed, with its greater extension and nutrition small intervals may sometimes be seen ; this enhanced feeding also may originate growth into twigs (brindilles) or long dards, that is some woody growth, otherwise generally but little wood extension occurs on the spur. We may regard it as probable that when growths are induced from such regions they are derived from main eyes, but we cannot exclude altogether the possibility of an origin from stipularies.

Adventitious Eyes.—Botanists advise us of a further class of eyes which are called adventitious, whose very existence is evolved by some damage or injury ; they seem to claim that any undifferentiated cell is capable of giving rise to an eye rather than that foci of germinal matter are concentrated at certain spots during ordinary growth. From what has been shown to you, it would seem that so-called adventitious eyes—that is the production of new eye foci in response to the removal of a limb or branch—are quite unneeded for the replacement of the loss. There are plenty of pre-existing eyes to supply the tree's new needs.

Whether, departing from our main theme, similar provision of eye foci occurs on roots without any intervention of wound or damage cannot be answered until further research has been made. But knowledge would be useful if it aided us in placing the troublesome formation of suckers by plums under control.

Sometimes, after cutting back heavy limbs, the shoots arising in response may be placed in pairs at the same levels and close together ; in such cases one shoot precedes the second and for a while exceeds it in length and girth ; it would appear legitimate to assume that these come from hidden stipulary eyes whose main eye has suffered death.

The art of summer pruning consists in evoking dormant eyes and in making them grow into fruit buds or woody growths. To attain to this a greater flow of sap must be directed to them. This flow of sap is regulated by the leafage which is permitted to remain and also depends upon the maturity of the eyes concerned. If too little sap flow is induced, the eyes may still remain too starved ; on the other hand too much sap may engender a woody growth where none is desired. The presence of adequate sap-drawing organs (leaves) is important and becomes the first thought in the mind of the pruner.

Leaving aside the original direction of LORETTE to prune when a shoot is of pencil thickness, for when I visited Wagnonville just before the war out of the hundreds of shoots that I saw cut, not more than a few dozen had attained this size, the other criterion is the degree of woodiness; this essentially runs hand in hand with the degree of ripening of the eyes on the shoot. If we cut to a well-formed eye, as we do when a baby fruit bud is showing at the base, this eye is ready to grow, and to draw sap which, if it got directly to the baby bud, might cause it to make a woody shoot instead of the desired fruit bud. Again, if cutting is too early, whilst things are still green and sappy, the whole lot of young dormant buds eyes may seek a short way in death by desiccation.

Regulation and direction of the sap flow are the mainstays we must bear in mind during leaf-time pruning.

I hope that you, my Lord Chairman, and many here present will beseech Mr. LEES when he corrects the proofs of his Paper to substitute the word " standard " for " Lorette." Let him say " modified standard pruning." The whole of LORETTE's pruning is done while the things are active. Mr. LEES waits until growth has completely ceased to do his final pruning. The final pruning in the Lorette system is done before the leaf falls, in order to draw the last of the sap into the forming fruit buds, which is quite a useful thing. I hope you will beg him to alter his terminology and not use the word " Lorette " in regard to his modified pruning. If we are to be scientific we must have proper language and use our words correctly; without that nobody knows what one is talking about.

Mr. GOUDE : I would like to congratulate both Mr. WILSON and Mr. LEES on the admirable papers they have given us, and on their explanation of a very difficult subject. It takes some one who is very keenly interested in pruning to write papers which can be followed as closely as we have been able to follow these this afternoon.

What struck me most perhaps in listening to Mr. WILSON was that he made no reference to some varieties that should not have their leaders touched if you want them to remain fruitful trees. In commercial plantations, which I think offer a very good guide so far as fruitfulness is concerned, we very rarely dream of heading back any of the leaders of 'Bramley's Seedling' or 'Newton Wonder.' Of course that probably may lead some of you to think that the trees will grow to an enormous size. As a matter of fact they do not do that,

FIG. 7.—PEAR 'LOUISE BONNE OF JERSEY.'
Lorette pruned (Mr. Bostock).

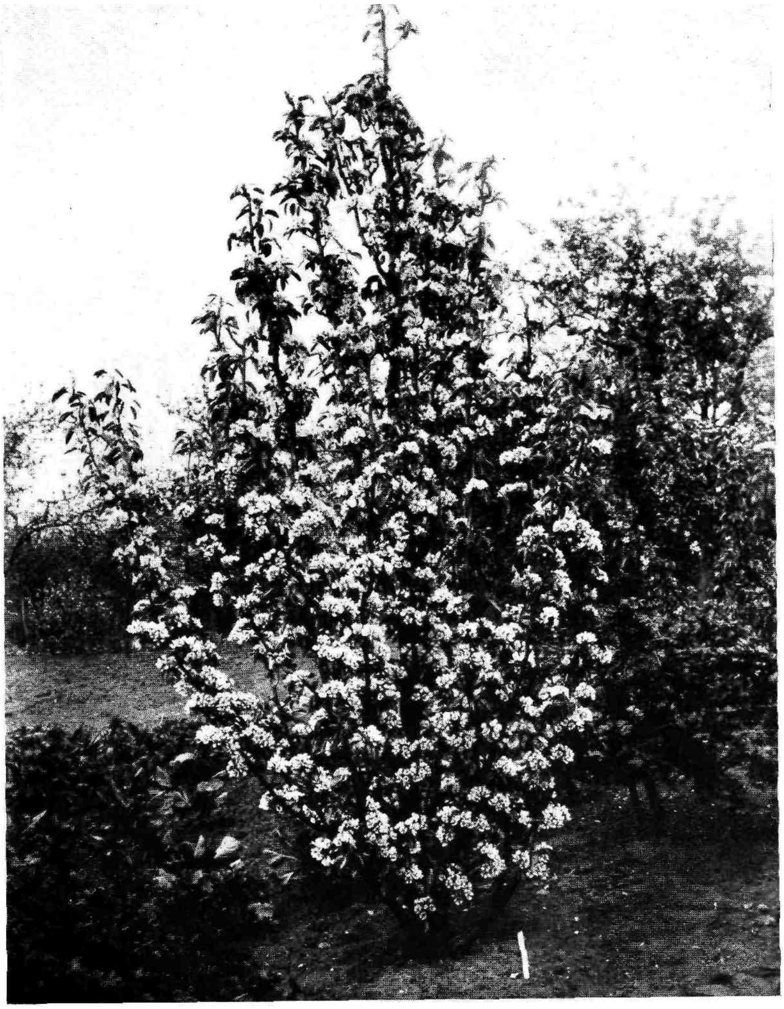

FIG. 8.—PEAR 'DOYENNÉ DU COMICE.'
Lorette pruned (Mr. Bostock).

[To face p. 29.

because most fruit trees have a normal shape and also a normal size which they eventually reach, and the result is that they remain of quite manageable dimensions. What we do in order to keep the tree, or stiffen up a branch if it has got weak through being allowed to run too long, is to cut it back to the weaker lead. We find this has quite a different effect on the tree as far as the lateral growth is concerned from what you would get if you cut back the leader. Other than that we usually follow out the practice as described by Mr. WILSON for winter pruning, except that I would have liked him to state more definitely the actual number of branches that he would recommend for the different varieties in a particular system of planting. That is a very important point. When one begins to talk about pruning and say "Leave your branches thin so that the air can reach all parts of the tree and also the centre," I find most amateurs are fogged as to the exact distance the branches should be apart. Sometimes it is a very good guide to say if the trees are 12 ft. apart they should have 12 branches. It does not actually work out quite so few as that in practice, but it is quite a fair guide to the number of branches the tree requires. If they are 30 ft. apart that would mean 30 main branches to the tree; that would be somewhere in the neighbourhood of the correct amount.

Then we come to the question of the pruning of laterals. In both papers we have heard a great deal about cutting laterals close in, so that the fruit spurs should be formed as close as possible to the branches. I know it is a general recommendation, and I believe that most people think the fruit is safer there than it would be if it were on a longer spur. That is not our experience. Under our County of Norfolk Committee we have at least fourteen acres of apples that are under various systems of pruning. Our method in order to get the tree to fruit as soon as it has reached a fruiting size is to cut the spurs long. We do not stop at 3 or 4 inches; with strong varieties we never hesitate about leaving spurs on the trees 12 and 14 inches in length. That length of spur reduces the vigour of the tree and also the vigour of the spur or the lateral that you can take for forming the spur. The result is that the following year there are invariably fruit buds formed on that long lateral you have left. That is a much shorter method of building up fruit trees on the lateral or winter pruning system. Having got your fruit buds—and we never fail to get them under that particular system of pruning—we then cut the spurs closer in, perhaps in the following year, and when that long lateral has developed several fruit buds, we then cut it to two. If the condition of the tree warrants it, we should cut it back to one spur on the weaker growing varieties, such as 'Cox's Orange' or 'Allington Pippin,' and varieties of that description.

I rather differ from Mr. WILSON on the necessity of cutting immediately above the bud when you are pruning. If you cut immediately above the bud in the winter time no healing can take place. If you are going to cut trees for the purpose of shaping those trees and

building up what I believe Mr. LEES termed "scaffolding" branches, you will find that most of those buds that are cut close in or even immediately above, that is in the orthodox manner, will break weak. In order to overcome that and make sure that we get the buds to make the proper shoots or buds that we require, we always cut well above them and leave quite a good snag. That snag occasionally will become infected with what most people fear, that is the canker fungus, *Nectria galligena*, but in the majority of cases that infection dies out. We have noticed it for years and over quite a large area of fruit trees that these infections do take place, but they are far worse and upset the cut much more where the cut has been made close down to the bud. We always say cut well above the bud, which is absolutely opposite to what has been stated, but we have done it for quite a number of years and we can always get a good strong growth from this bud; we cut well up and leave a good snag of wood. When we had these pieces of wood examined, the mycologist told us there undoubtedly was infection from the Nectria fungus which had taken place between the latter end of February and the early part of May. The Nectria is a parasite, that is it grows in living wood, and if that piece of wood dies out you will find in the majority of cases no further development of fungus takes place, and actually the dead piece of wood drops off owing to the layer of cells that build up in the laterals.

The hour is rather late, and I am afraid this session has lasted rather longer than was expected, but I would like to take up the point Dr. DURHAM made in reference to terminology.

We have heard the branches of fruit trees referred to this afternoon as "cordons." I think that is altogether wrong. We refer to a fruit tree as being a cordon. The cordon is a method of producing an artificial form in fruit trees and it is nothing more than that. I see no objection to that word being used in reference to that particular type of fruit tree to which it is applied, but when you begin to refer to the main branches in a fruit tree as being "cordons" I think that is altogether wrong, because I do not think that you want anything more than "branch" or "main branch," or "a secondary branch" if you like, when you are referring actually to the branches of the trees.

We come to another reference that has been made this afternoon, that is "scaffolding branches." I always understand "scaffolding" as something which is really put against a building or something of that sort, holding it up. Personally I think it is wrong to refer to branches as being the scaffolding branches of fruit trees.

Then there was another remark that really went home very closely to my heart. That is that we should not refer to Lorette pruning when we are really practising something else. As a matter of fact, the system of pruning that was published by JOHN HARRISON, who was a Fellow of this Society a hundred years ago, really describes that system of pruning in a much clearer manner than the translators of LORETTE have been able to give to us. We have one in Norfolk, J. A. CHRISTIE, Esq., M.P., a very keen amateur gardener, who has followed

out Harrison's system ; he has very fruitful fruit trees and is always a most successful exhibitor at all our local shows.

Mr. WILSON : With reference to the question of leader tipping, I quite agree with Mr. GOUDE. I really should have mentioned that some varieties are best left alone, but that would depend upon those conditions that affect the cutting of the leader. I had not the time to deal with all the points in detail—Mr. GOUDE of course only dealt with one or two points—but my paper was spread over a larger range. In some varieties leaders should certainly be left unpruned.

Mr. GOUDE mentioned leaving a snag of wood in cutting above the leader. I think, apart from the danger of disease getting in, there is the question of the next extension being influenced adversely. I did not mean to imply that the leader should be cut very close to the bud, but the cut should not be below the base of the bud. I always find that if a snag of wood is left above the bud the resulting leader or extension is influenced in the wrong direction. Very often the new shoot grows out at a very wide angle.

With regard to the question of cordons. I used the term "cordons" to illustrate my points to those not very experienced in pruning, but the term should, of course, only be applied to the actual cordons as we really know them. My use of the term was merely to illustrate the construction and treatment of the branches of the tree.

Mr. LEES : There have been one or two criticisms made to which I ought to reply.

First, the question of "pencil thickness." In my paper I put a pencil thickness as the third condition for judging whether the thing was ready, the first condition being the semi-lignification. Both Mr. BOSTOCK and Dr. DURHAM were good enough to inform me that I pruned at the wrong time when I got dead stumps in pears. I do not know why they assumed I pruned at the wrong time because I never told them when I did prune. As a matter of fact, I took the time by the usual recommendations, the semi-lignification and also the time of year which for the pear comes about the end of June. I have no reason to think the time was wrong. I would like to make this point very strongly, because I think it affects a great deal of the arguments made about pruning in general. The conditions in this country are decidedly different when you go from the east to the west ; there is a difference of climate and in any given year very often in the meteorological conditions. The result is the particular set of conditions is not the same in the east of England as in the west. You are advised with 'Bramley's Seedling' when the tree is going strongly to leave the leaders unpruned. If this treatment is given in the south-west of England to trees aged twelve to fifteen years, strong shoots are made from the terminal bud and from one bud behind the terminal, and then absolutely no shoots from that point all the way down to the base, a length of 18 inches or possibly even 2 feet. It was not a bit of good advising us at Long Ashton at that time to prune lightly or not prune at all and the wood would break back.

It would not. It just simply remained a bare pole. That was not the fault of Long Ashton, it was the conditions at Long Ashton, and naturally other methods had to be applied to overcome this difficulty. I would point out, therefore, that a great many recommendations may achieve success in certain parts of the country, but it does not necessarily follow that the same recommendations can be applied in other parts. There seems to be a more or less gradual change over from the hotter, drier east to the cooler, moister west conditions which make a most enormous difference.

The only other point was Dr. DURHAM'S suggestion that when I correct the paper I leave out all reference to Lorette in describing the system we personally use at the farm. I certainly thought if I did not mention Lorette I should get it in the neck—I owe a considerable amount to Monsieur LORETTE in the methods we have finally adopted—but I seem to have got it in the neck because I did mention his name. However, it will of course be quite easy to leave it out, but I thought it really was rather rude to Monsieur LORETTE not to acknowledge the debt we undoubtedly owe him.

FRUIT TREES FOR SMALL GARDENS.*

By A. N. Rawes.

Even the small and already well-stocked garden can and should have its complement of fruit trees. At this suggestion, amateurs less experienced with fruits are apt to picture large, cumbersome standard trees or big, spreading bushes with sprawling branches that shade and spoil nearby shrubs and plants, and rambling roots encroaching upon flower beds and borders. Unfortunately, examples of this sort of thing may be seen everywhere. While it is true that large standard trees of Apples and Pears or Plums and Cherries can be both ornamental and productive, only rarely are they suitable for planting in the garden where space is limited. The place for these large trees is spaced widely apart in the grass orchard or arranged about the lawn, where their shade and beauty may be appreciated and the interests of beds and borders will not be sacrificed. For the small garden, trees of compact growth and neat habit—such as the cordon, espalier and fan-shaped trees and the dwarf growing bushes, are much to be preferred, and if proper choice is made, and the lay-out carefully planned, they need take up no more room than the average shrub, they will be distinctly ornamental and add greatly to the enjoyment and profit of the garden.

In comparatively few small gardens is full use made of the bare spaces against house walls and boundary fences, for the production of home-grown fruit. It will be found much more convenient to have fruit trees growing in neat and shapely form in these positions, even though it be at the expense of a few unproductive " creepers " and the like—rather than to overcrowd the garden with the usual collection of standards and vigorous growing bushes which occupy much valuable space and involve considerable labour, often with small return. Properly trained, with branches spaced out in orderly shape, all well within reach for the annual operations of pruning, spraying, harvesting, etc., these dwarf, trained trees combine ease of management with economy of space and provide fruit of excellent quality for many weeks or months in the year. There are fruit trees of one kind or another suitable for growing against the wall or fence of each and every aspect, so that not a yard of available space need go unfurnished.

A few explanatory remarks as to the " make up " of the different forms of trained trees most suitable for the small garden may be helpful.

The simplest form—the cordon tree—consists of a single straight stem, furnished with fruiting spurs along its entire length; no branching at all is permitted. Cordons may be planted upright

* Prepared for but not read at the Conference.

against the wall or fence, or wire trellis; more often they are planted obliquely and trained with the stem sloping at an angle of 45 degrees or so. This slope reduces the height of the established tree and tends to increase fruitfulness. Double and treble-stemmed cordons, while not so generally grown, can be obtained and are ornamental and fruitful. The horizontal cordon is sometimes planted as an edging to the pathways and lawn—the single stem of this running horizontally, a couple of feet or less above ground, making a novel and fruitful border.

The single stem cordons might be planted in a straight line along the pathside, as a background for the lawn or border, as a division between vegetable and flower beds and so on, with excellent effect. Apples and Pears do especially well in the cordon form of training, so do Red Currants and Gooseberries—the Apples and Pears are planted 2 feet apart, and the Currants and Gooseberries only 12 inches apart in the row, with, of course, a proportionately wider spacing for the double and treble-stemmed trees.

The horizontal or espalier tree is a very popular form of training. It is furnished with four or five or more pairs of horizontal branches running straight out at right angles on either side of the centre main stem, with a space of a foot or so between the branches. A well-formed tree will reach to a height of 5 feet or 6 feet though the number of horizontal branches can be limited according to the height of the wall or fence to be covered. Each espalier tree, when full grown, would occupy some 12 feet lateral space. Apples and Pears do well in this form of training, and like the cordons, will furnish the walls and fences and provide a decorative edging or background for the border or lawn.

Plums, Cherries, Peaches and Nectarines, and Apricots, rarely succeed in cordon or espalier form. The restriction imposed upon growth by the hard pruning entailed in these forms of training, is too severe to promote healthy growth or free cropping, and when any of these fruits are to be grown against a wall or trellis, then the fan-shaped tree is by far the most suitable. The fan-shaped tree, as its name implies, is trained with a number of branches radiating fan-wise from the top of the main stem—which may be short or long, according to the height of the wall and space to be filled. The branches, some eight or ten in number, are evenly spaced out over the wall or fence, each tree when full grown occupying about 12 feet lateral space.

For planting in the open garden, the dwarf-growing and quick-fruiting bush-shaped trees are usually to be preferred, though Pears are often grown in pyramid form. The main difference in these is that while the bush-shaped tree is trained with an open centre, and branches spaced out to form a bowl or cup-shaped " head " to the tree, the centre of the pyramid tree is filled with a continuation of the main stem, from which tiers of branches radiate on all sides. These trees would be planted at anything from 10 feet to 12 feet apart.

All these forms of trees—and there are others, equally compact and neat-growing, but less generally grown—are highly productive and yield fruit of excellent quality, and it should be possible to fit them into even the smallest garden without interfering in the least with other trees and plants.

When stocking the garden with small trained trees of these types, it is necessary to obtain material that has been grafted or budded on to the correct root-stocks, and carefully trained from the first season into the special form intended. It may be noted here, that any attempt to convert an established bush or standard tree on a vigorous root-stock, into a neat growing espalier, cordon or fan-shaped tree, will in all likelihood meet with failure.

The important part played by the root-stock on to which the variety of Apple or Pear, Plum or Cherry is propagated in the nursery—by grafting or budding—is not always fully appreciated by the inexperienced amateur. The root-stock influences in very marked manner the vigour and ultimate size of the tree, the time it takes to come into bearing, cropping capacity, and many other characters. As a result of long and careful experimental work at the Research Stations in this country—notably at East Malling and Long Ashton—root-stocks for all kinds and forms of trees have now been selected and standardized and reputable fruit tree raisers have a wide range of graduated root-stocks of known performance and value to work with.

Taking Apple stocks for example, when propagating Apple trees to be trained as cordons or as very dwarf growing bush trees, the nurseryman would probably use the 'Jaune de Metz' paradise stock (Malling No. IX), for small bushes and espaliers he would use the 'Doucin' paradise (Malling No. II), for large permanent bushes the 'Broadleaf English' paradise (Malling No. I), and for more vigorous trees, as standards and half-standards, the stocks known as Malling No. XII, No. XIII, or No. XVI, all of which produce big, strong growing trees that are comparatively slow in coming into bearing. For the dwarf trained Pear trees there are selections of Quince stocks, and while for Plums and Cherries very dwarfing stocks are not yet obtainable—in the same degree as are available for the Apples and Pears—there is a range of suitable material for the nurserymen to work with. There should be little need for the amateur to make a close study of the selection of special root-stocks for each and every form of tree—that might be left to the specialist and the nurseryman, but those interested in the work that has been done may obtain the information from the Reports published by the Research Stations mentioned.

Unless the initial shaping and training of the trees is to be in skilled hands, it is unwise to purchase "maiden" or one-year-old trees for planting. The ultimate shapeliness and good form of the trees will depend very largely upon the quality of the knifework in the first few years, and it is better that this should be left to experienced nursery hands. Established trees with a frame of well placed branches already built up and—especially in Plums and Cherries—trees that have been

transplanted annually in the nursery to establish a strong fibrous root system, should be chosen for garden planting.

When selecting trees to plant against the walls and fences of different aspects, it should be recognized that certain kinds and varieties will suit some positions better than will others. The selection for even the bleak north wall is by no means limited, however.

The first choice for the north-facing wall is usually the 'Morello' Cherry, trained as a fan-shaped tree. Early ripening Plums and Pears and the early dessert Apples will also thrive there; while Red Currants and Gooseberries, grown as cordons against the north wall will ripen their crops much later than the bushes in the open garden, thus providing a succession of berries. A wall or fence facing south may be furnished with almost any kind of fruit tree, but is usually reserved for the more tender kinds and varieties which require shelter and warmth to bring their crops to perfection—as the Peaches and Nectarines, Figs and the hardy Grapes. Here too, the late-ripening Pears will ripen and mature their fruit satisfactorily, when they would probably fail elsewhere in all but the warmest and most sheltered gardens. For the wall facing east, mid-season Plums and the early ripening Cherries and Pears, also early dessert Apples might be chosen, and room might be found for a few cordon Red Currants and Gooseberries, to provide early berries. Against the west wall, often almost as sheltered and sunny as the south wall, Peaches and Nectarines can be grown in all but the coldest districts, as well as the finest quality Pears, Plums and Gages, and the Apricots. In wet localities, however, Plums and Cherries would be better against a wall facing east, where, sheltered from western gales the ripening fruits would be less likely to crack or split in a rainy season.

Autumn is rightly regarded as the best time for planting fruit trees but they can be put in with safety at any time during winter, while the trees are dormant, providing the soil is then in suitable condition to receive them—neither water-logged or frost-bound. No elaborate preparation for planting, beyond deep digging, will be necessary when the garden soil has been well cultivated for several years. The ground against the house side and boundary fence, however, is generally anything but ideal for fruit trees to root into and before planting in these position—or into extreme types of soil as heavy clay or very light sand—some special preparation should be made. The site for the border should be dug out to a depth of 2½ feet over a strip of ground 3 feet to 4 feet wide and the length of the wall to be furnished, and, if the ground is very heavy, tile drains should be laid along the bottom and covered with a 5-inch or 6-inch layer of brickbats and rubble. Turves can then be laid grass side down over this and good loamy soil filled in on top. It is not necessary or desirable to mix in a lot of manure with the soil; rather should the manure be applied after planting as a surface mulch around each tree. For the "stone" fruit trees good drainage is most important, and for these a special compost should be prepared, made up of loam and crushed mortar rubble, mixed in the

proportion of about 1 part of mortar rubble to 4 or 5 parts of loam, adding to this charred garden refuse, wood ashes, or old leaf soil; the whole being thoroughly mixed together and trodden firmly as it is filled in. When planting a tree against a wall, it is usual to set the lower part of the stem some 3 inches or 4 inches out from the wall base, and to incline the top of the tree slightly so that it meets to the wall.

The branches and shoots of wall trees should not be fastened to the brick or woodwork with nail and cloth shred. It is much more convenient to fix galvanized wires vertically along the wall, about a foot apart and held out some 2 inches or 3 inches from the wall, with the special eyelet wall nails—this forming a permanent trellis to which the growths may be secured, with the minimum of labour and damage to the background.

POLLINATION IN APPLES, PEARS AND PLUMS.*

POLLINATION is the process of depositing pollen upon the stigma of a flower. It is the usual preliminary to the fertilization of the ovule and the development of fruit and seed in all the flowering plants. Without pollination the series of changes resulting in seed and fruit production cannot as a rule begin, and only rarely is fruit produced if pollination fails.

Since the prime requirement of the fruit grower is that his trees shall fruit, he has not only to induce them to flower but his treatment must also conduce to the production of fruits from the flowers. Effective pollination thus comes within his purview, and though the matter is not so simple as one, knowing that both pollen and stigmas upon which it may fall are present in every flower, might suppose, it is fortunately one to a large measure within the power of the grower to contrive.

The pollen falling upon or carried to the stigmas of a flower may come from (1) the same flower, (2) another flower of the same plant, (3) a flower of a different plant of the same species, (4) a flower of a different species of the same kind, or (5) a flower of a different kind of plant.

Pollen of the last type is very rarely effective in producing seeds or fruits; pollen of the fourth kind is sometimes effective; pollen of the third kind is generally but not always effective; pollen of the first and second kinds usually behaves alike and may or may not be effective; if it is, the plant is said to be self-fertile, if not, it is said to be self-sterile.

Self-sterility is a very common phenomenon. Even such a prolific seed-producer as the common field poppy is self-sterile. Nature seems to have adopted various contrivances to ensure self-sterility or at least to render self-ferility unlikely except as a last resort. The pollen and ovules are sometimes produced in separate flowers (as in hazels) or even on separate plants (there is one apple in which no stamens are found), or stamens and stigma ripen at different times, or obstacles occur in the flower to prevent the pollen from reaching the stigma, and so on. Cross pollination is therefore frequently necessary, and various agencies are concerned in bringing it about.

It should perhaps be pointed out here that what we call a "variety" of apple, pear or plum corresponds precisely to a "plant" in the remarks just made. Every 'Cox's Orange Pippin' apple tree in existence has been grown from the one seedling plant which was raised by Mr. Cox of Colnbrook; parts of this one tree have been merely

* Prepared for but not read at the Conference.

provided by the gardener's art assisting Nature with new sets of roots, and so the one seedling—the variety, as for convenience we call it; the clone, as more precise language now designates it—has been spread into every apple-growing country in the world.

So with 'Williams' Bon Chrêtien' pear—all derived from the one seedling at Aldermaston, no matter by what name the pieces may be known, whether Stairs' pear or Bartlett or Williams. So too with 'Victoria' plum; every one of the vast numbers of trees of this "variety" nothing but pieces of the seedling raised at Alderton, and so with almost every other "variety" of plum and pear and apple. Each tree of the clone has all the characteristics of the original seedling (save that at times, though rarely, bud sports arise and give a new variety differing from the original in some small but constant manner), and if one tree of the variety is self-fertile or self-sterile then all the trees of that variety will be equally self-fertile or self-sterile. There are exceptions to this rule, but they appear to be rare. One is offered by 'Williams' Chrêtien,' which in some parts of America is reported to be self-sterile, in others self-fertile. This may be an example of bud-sporting.

Although the Rev. GEORGE SWAYNE pointed out in our Transactions in 1822 that cross-pollination was necessary in the pear 'Gansell's Bergamot,' which set no fruit without it, the necessity for it was not realized, and perhaps never would have been realized by the fruit-grower, while the mixed apple, pear or plum orchard was the rule. When large areas began to be planted with one variety of apple or pear or plum the curious fact that the outer part of the plantation was more fruitful than the inner began to force itself upon the attention of growers, and they began to seek a remedy.

A pointer to the remedy was found by an interesting chance during experiments concerning fire blight in pears in America, and in 1895 WAITE published his observations in this connexion on pears in America, and in 1898 on apples.

The first English experiments were made with apples and pears by F. J. CHITTENDEN at Chelmsford in 1902 and 1903, and published in our JOURNAL. They were continued by him at Wisley with the assistance of various students, and the work is still in progress there by A. N. RAWES. It was later extended to plums.

Soon after its establishment similar work was commenced at the John Innes Horticultural Institution, where W. O. BACKHOUSE, Miss IDA SUTTON and M. B. CRANE (who is still working on the matter) have done notable work, especially with plums and cherries. C. H. HOOPER of Wye has since 1911 devoted much time to the matter also, and has published the results of his numerous trials with apples, pears, plums and cherries very widely. To these and others we are indebted for the greater part of the information now given.

Investigators have not been idle abroad and a mass of literature has appeared, and most of it has been summarized from time to time in the JOURNAL, R.H.S.

These investigations have been directed to three main ends, viz.:

(1) To discover whether a variety is self-sterile or not.
(2) To ascertain the cause of self- and inter-sterility.
(3) To discover the best means of overcoming the difficulties imposed by self-sterility.

Any discussion of the second of these is foreign to our purpose and it must suffice to say that while there are degrees of goodness of pollen in different varieties, in most, and probably in all, there is amply sufficient good pollen to produce a good crop, other things being equal. It cannot be said that in apples and pears any all-embracing explanation has been found for self-sterility, and the matter is complicated by the readiness of some varieties of apples and pears to form perfectly good fruit without producing any seeds. With plums the case seems rather different. Seedless plums rarely, perhaps never, occur, and it may be possible by microscopic examination to predict with certainty whether one particular variety of plum will cross with another, but at present every variety of apple and pear presents a separate problem which has to be proved. It will probably be found impossible to alter a moderately self-fertile apple by any soil treatment or other change in environment to a very self-fertile one, though it may be found possible to modify the degree of self-fertility to some extent by providing conditions which would prolong the life of the individual flower.

The Pollination Problem as it applies to the Apple.

The fact soon became evident that some varieties of apples set a fair proportion of the flowers when only the pollen of the same flower was allowed to fall on the stigmas, while others set little or none.

The former were in the minority, and they included a certain number in which pollination stimulated the fruit to develop without fertilizing the ovule: seedless fruits were produced. The term self-fruitful therefore more accurately expresses the condition where fruit is produced without the intervention of foreign pollen (that is, pollen of another variety).

It must be remembered that many other factors besides compatibility between pollen and ovule determine fruitfulness, and not least is the matter of maturity of the tree and all that it connotes. Results obtained from trees that are in fruit-bearing condition are alone reliable, and results based on any others may be entirely misleading.

The degree of self-fertility shown by different apples varies greatly. 'Stirling Castle,' 'Lord Grosvenor' and 'Allington Pippin,' for instance, may set a sufficient proportion of the flowers to give a crop, while 'Cox's Orange Pippin' sets very few even in the most favourable circumstances, as do 'Bramley's Seedling' and 'Lane's Prince Albert,' as well as many others. Almost all varieties of apples, perhaps all,

set some fruits at times when pollinated by their own pollen alone, but generally insufficient to produce a crop. In other words, to produce a crop the great majority of apples require to be pollinated with pollen of another variety. Do even the more self-fruitful varieties set greater numbers of fruits when cross-pollinated than when self-pollinated ?

The following figures answer this question :—

At Wisley 106 flowers of 'Allington Pippin' pollinated with their own pollen set 7 fruits only (6½ per cent.), whereas 444 flowers crossed with pollen of various other varieties set 95 fruits (21 per cent.). Of 262 flowers of 'Rev. W. Wilks' pollinated with their own pollen 52 set (20 per cent.), while of 388 flowers pollinated with pollen of different varieties 97 set fruits (25 per cent.). 'Ribston Pippin' set 25 fruits out of 248 flowers self-pollinated (10 per cent.), whereas 123 fruits resulted from the cross-pollination of 582 flowers (21 per cent.).

The figures contrast with, for instance, those of 'Cox's Orange Pippin,' which of many hundreds of flowers self-pollinated only four have set fruits, of 883 flowers crossed with various varieties 141 have produced fruits (*i.e.* 16 per cent.).

It is thus evident that for a full crop opportunities for cross-pollination are desirable for all varieties of apple, and necessary for most. While we might, where a few trees only are concerned, follow the example of the Rev. G. Swayne and cross-pollinate our fruit trees by hand, this method is impossible where many trees are concerned, and unnecessary except in the orchard house, provided the varieties to be crossed flower at approximately the same time, the agents for the carrying of the pollen are present, and the varieties to be crossed are sufficiently near one another.

Investigations make it quite clear that the wind plays no direct part in carrying pollen from one apple tree to another. The only part it plays is by affecting adversely at times the active agents in carrying pollen. Mr. G. F. Wilson has carried out at Wisley a long series of observations and experiments to ascertain what the most active agents are, and an account of his work is given in the Journal, R.H.S., vol. **51,** p. 225, and vol. **58,** p. 125. It is evident that while a great number of insects are apt to visit the flowers of apples and become dusted with their pollen and so carry it to other flowers, the most systematic and industrious agents in this work are the hive bees and the wild bees, especially the humble bees. It is probable that at Wisley the humble bees are relatively more numerous than in many fruit plantations, for the wild country in the neighbourhood of the garden provides ideal places for their nests. Their activity, however, in all kinds of weather makes them most important agents, and in a season of inclement weather almost the only important agents in carrying apple pollen, and the clearing out of hedge bottoms and the destruction of headlands may be carried out too rigorously for the ultimate good of the orchards. In fine weather hive bees may be the more potent both from their numbers and from their more

consistent behaviour, and it is good practice to ensure the presence of hive bees in the neighbourhood of the apple plantation.

In planning an orchard the necessity for having suitable varieties in proximity to one another must be borne in mind. Not more than four adjoining rows should be of one variety. Where this necessity has been overlooked a sufficient number of trees can be top-grafted with a second variety to provide the necessary pollen. Another method is to plant single trees of the minor variety in the plantations so that each is surrounded by eight of the major variety, that is, each block of nine trees has a pollinator in the middle.

The planting of a single variety of apple trees in a garden is not wise unless the garden is small and neighboured by gardens where other suitable varieties are planted.

Where there is room for only one tree a very self-fertile variety should be chosen or a branch of another variety with the flowers well out should be placed among the boughs of the tree when in flower.

The agents for carrying the pollen can thus be secured and the plantation arranged so that the carrying can be successfully accomplished.

The third question concerns the varieties which can be suitably mixed.

Here three considerations are involved:

(1) The commercial grower must use only varieties likely to be commercially profitable, and he may plant either equal numbers of each variety arranged as already suggested, or four to one of a major and a less important variety. The amateur is not so limited. His choice is much wider.

(2) The varieties to be planted together must be in flower at approximately the same time.

(3) Where there is a choice, consideration must be given to whether the pollen of one variety is more likely to bring about fruit production than another. The two varieties must be mutually cross-fertile.

This is not the place to suggest which of the vast number of apples are most likely to be commercially profitable, but in the list given below those likely to be planted for commercial purposes are included.

When a considerable number of varieties of apples are grown it will be found that the flowering time from first to last is spread over some weeks, and the flowers of the earliest trees to bloom will be completely past before the latest have burst their buds.

The matter has been investigated at Wisley, and records show that the relative order of flowering of the varieties are the same from year to year, and comparison with records made in various parts of the world make it clear that the order is the same wherever the varieties are grown. A relatively early variety (like 'Red Astrachan') in one locality is relatively early over its whole planting range; a relatively late one (like 'Royal Jubilee') is late wherever it is planted.

Lists of the order of flowering have been published (see JOURNAL, R.H.S., **37**, p. 350; **47**, pp. 8, 15 and **59**, p. 85), and readers who do

not find the variety they seek in the following list should consult these accounts.

The present list gives only the more commonly cultivated varieties in the approximate order of flowering, and indicates by means of brackets those which may profitably be planted together, since they flower at such a time that pollen will be available for the requirements of any two.

Red Astrachan.
Manks Codlin.
Golden Spire.
Irish Peach.
Duchess of Oldenburgh.
George Neal.
Keswick Codlin.
Egremont Russet.
Stirling Castle.
Devonshire Quarrenden.
St. Edmund's Pippin.
Lord Suffield.
Ribston Pippin.
Exquisite.
Red Coat Grieve.
Warner's King.
Ben's Red.
Baumann's Reinette.
Lord Hindlip.
Bismarck.
Beauty of Bath.
Claygate Pearmain.
Lord Grosvenor.
Roundway Magnum Bonum.
Charles Ross.
Duke of Devonshire.
Early Victoria.
Wagener.
Arthur Turner.
King of Tompkins County.
Brownlee's Russet.
Premier.
Allington Pippin.
Beauty of Kent.
Cellini.
Worcester Pearmain.
Alderman.
Lord Derby.
Ecklinville Seedling.

Allen's Everlasting.
Lane's Prince Albert.
Lord Lambourne.
Millicent.
Peter Lock.
Bushey Grove.
Wealthy.
James Grieve.
John Standish.
Excelsior.
Joy Bells.
A. W. Barnes.
Ontario.
Opalescent.
Cox's Orange Pippin.
Norfolk Challenger.
Geo. Carpenter.
St. Cecilia.
Monarch.
Victory.
St. Everard.
John Waterer.
Mr. Prothero.
Cellini.
Lord Derby.
Bramley's Seedling.
Sowman's Seedling.
Ecklinville Seedling.
Thorpe's Peach.
Ellison's Orange.
Laxton's Superb.
Allen's Everlasting.
Rosemary Russet.
The Queen.
Rival.
Worcester Pearmain.
King of the Pippins.
Alfriston.
Lady Sudeley.
Peasgood's Nonsuch.
Rosamund.

Cutler Grieve.	Annie Elizabeth.
Wealthy.	Lord Burghley.
Beauty of Hants.	Encore.
Blenheim Orange.	Laxton's Pearmain.
Hawthornden.	Eady's Magnum.
William Crump.	King George V.
Herring's Seedling.	New Hawthornden.
Barnack Beauty.	S. T. Wright.
Grenadier.	Newton Wonder.
Potts Seedling.	Morley's Seedling.
Wellington.	Mère de Menage.
Reinette du Canada.	Edward VII.
Cox's Pomona.	Cottenham Seedling.
Mr. Gladstone.	Heusgen's Golden Reinette.
Seabrook's Red.	Court Pendu Plat.
Coronation.	Royal Jubilee.
Gascoyne's Scarlet.	

This list indicates the approximate order of flowering, so that a variety in its early part may be regarded as an early variety, one near the end a late one, the others mid-season. The closer together they are, the closer, on an average, will their flowering times be, and the more likely they are to provide one another with the necessary pollen.

There remains the question whether one variety is better than another for providing pollen for a given variety. This is very difficult to answer, for negative results following pollination need to be regarded with suspicion. A very large number of crosses need to be made and consistent figures obtained over a number of years before any certain conclusion can be arrived at, and we have nothing like enough figures to go upon yet.

As an illustration of the danger of basing recommendations on small experiments we may take some results of pollinating 'Ribston Pippin' in different ways. In 1931, 47 flowers were pollinated with 'Ribston Pippin' and 7 fruits resulted (14 per cent.); 56 were crossed with 'Ecklinville' pollen and 21 fruits resulted (37 per cent.).

In 1929, 67 flowers self-pollinated gave 6 fruits (9 per cent.), and four crossed with 'Ecklinville' gave 3 fruits (73 per cent.), or again, in 1931, 90 flowers of 'Ribston Pippin' pollinated with 'Beauty of Bath' pollen gave 21 (23 per cent.) fruits (62 at the first count apparently set), yet in earlier years 17 flowers pollinated by the same variety gave no fruits. One might have concluded that 'Beauty of Bath' was of no use (in fact, worse than useless, for several self-pollinated fruits had set on the same trees), yet 1931 utterly contradicted this.

Another aspect of the matter is afforded by the fact that in some varieties, *e.g.*, 'Ribston Pippin,' a considerable proportion of the pollen grains fail to germinate, yet pollen of 'Ribston Pippin' will often bring about a strong set of fruit in other varieties, as may be seen from the following, though all figures are too small to allow percentages of set to be calculated.

4 flowers	'Warner's King'	×	'Ribston Pippin'	gave	3 fruits.
8 ,,	'Rev. W. Wilks'	×	,,	,,	3 ,,
14 ,,	'Ontario'	×	,,	,,	6 ,,
4 ,,	'Newton Wonder'	×	,,	,,	4 ,,
15 ,,	'Lane's Prince Albert'	×	,,	,,	3 ,,
16 ,,	'Encore'	×	,,	,,	5 ,,
16 ,,	'Frogmore Prolific'	×	,,	,,	7 ,,
43 ,,	'Ecklinville'	×	,,	,,	1 ,,
12 ,,	'Cutler's Grieve'	×	,,	,,	11 ,,
13 ,,	'Brownlee's Russet'	×	,,	,,	4 ,,
9 ,,	'Beauty of Bath'	×	,,	,,	4 ,,

Thus the somewhat doubtful pollen of 'Ribston Pippin' is potent *enough on a wide range of varieties of apple, with one possible exception.*

It may be taken then that so far as we know any variety flowering at the same time is likely to provide pollen suitable for any other variety. As will be seen, this is not the case with plums.

Pollination of Pears.

The facts regarding pear pollination are similar to those with apples, save that the main agents in carrying pollen are drone flies and bluebottles, followed by humble bees, and then by hive bees. This is no doubt due in part to the earlier flowering of the pear in weather as a rule less congenial to the hive bee, and in part to the peculiar fishy odour of pear flowers which renders them attractive to the flies mentioned.

The results of many trials at Wisley have recently been published in the JOURNAL, R.H.S., vol. **58**, p. 288, in a paper by Mr. RAWES. These results indicate that there are similar differences in degrees of self-fruitfulness in pears as in apples (except that possibly a greater proportion of the varieties are self-sterile), and that even with the self-fruitful varieties cross pollination gives better results. The interplanting of varieties is therefore of great importance and a list of varieties in order of flowering will be found in the article quoted. The following list merely gives the order for some varieties more commonly grown:

Bergamotte d'Esperen.
Beurré Hardy.
Catillac.
Conference.
Comte de Lamy.
Beurré Superfin.
Emile d'Heyst.
Doyenne du Comice.
Josephine de Malines.
Marie Louise.
Pitmaston Duchess.
Thompson's.
Winter Nelis.
Williams' Bon Chrêtien.
Louise Bonne of Jersey.

As with apples, no varieties of pears are known to be inter-sterile, and the same type of interplanting as with apples can therefore be recommended.

Pollination of Plums.

Here again self-fertile and self-sterile varieties are found, but the position is different from apples and pears, since some varieties appear to be absolutely self-sterile and some are inter-sterile. This is no doubt connected with the fact that seedless fruits do not occur in plums. The fact of absolute inter-sterility in plums was discovered by experiments made at the John Innes Horticultural Institution, and the results there so far as they have been tested have been confirmed by experience at Wisley. Choice of varieties to plant together for cross-pollination purposes is governed here by two factors besides the desirability of the variety—viz. the closeness of the flowering period and the mutual compatibility of the varieties. The following varieties will not provide one another with pollen capable of causing the setting of fruit: 'Allgrove's Superb,' 'Coe's Golden Drop,' 'Coe's Violet,' 'Crimson Drop,' 'Jefferson.' 'Late Orange' and 'President' are also mutually incompatible, and the pollen of neither will set 'Cambridge Gage,' nor is the pollen of 'River's Early Prolific' effective on 'Blue Rock,' although the reverse cross sets a crop.

Perhaps a greater proportion of the varieties of plums will set fruit with their own pollen than of apples and pears, and such widely grown varieties as 'Czar,' 'Gisbourne's,' 'Monarch,' 'Oullin's Golden Gage,' 'Pershore' and 'Victoria' appear to be completely self-fertile; but the majority of plums also require cross-pollination to set a full crop, and such desirable varieties as 'Coe's Golden Drop,' 'Early Greengage,' 'Jefferson,' 'Kirke's Blue,' and 'Old Greengage' appear to be completely self-sterile.

Here again, then, it is wise in planting to interplant varieties that can provide one another with suitable pollen.

The flowering of plum varieties is usually much more simultaneous than that of apples or even pears; in fact, only about eight days separates the flowering of the earliest varieties from the latest, and as the flowering lasts from fourteen to twenty-four days there is always a considerable overlap. At the same time it is wise to arrange the earlier flowering varieties (so long as they suit one another) together and the later together. The following list gives many good varieties in order of flowering:

Grand Duke.
Monarch.
Jefferson.
Denniston's Superb.
Coe's Golden Drop.
President.
Early River's.
Decaisne.
Late Orange.
Comte d'Althan's Gage.

Kirke's Blue.
Czar.
Pond's Seedling.
Transparant Gage.
Washington.
Prince Engelbert.
Late Transparent Gage.
Stint.

THE BASIS OF CLASSIFICATION IN APPLES AND PEARS.

Chairman: Sir FREDERICK KEEBLE, C.B.E., M.A., Sc.D., F.R.S., F.L.S.

THE CHAIRMAN: The subject of this morning's Conference is one which of course is of the first importance. It is fundamental, and for that reason we have present only that small body of experts who are prepared, I hope, to take part in the discussion. The innumerable people who send their fruits to Mr. BUNYARD and Mr. RIVERS and others for identification are so confident that they will get the right answer that they do not even come to hear how this enigma of identifying fruits may be solved. But everyone who has given any attention to the subject knows that it is one of peculiar difficulty—a difficulty which does not attach to many other kinds of plants. It is difficult because, in the first place, apples and suchlike fruits are of very mixed origin; it is difficult because they do not grow on their own, but they grow on something else; and it is difficult because the fruits are very subject to seasonal influences. We should therefore be extremely grateful to those—particularly those growers—who, having a vast wealth of material at their hands, have set themselves to work out a better method of classification, because, until biological material is put into some sort of order, Biology must remain in a chaotic state. All other advances ultimately depend on a proper orderly arrangement of the material the study of which leads to those advances.

I hope, therefore, that we shall learn from Mr. BUNYARD and Mr. RIVERS that at all events the chief difficulties of classification have been overcome. It is too much to expect that they will be able to tell us how each of us may identify any apple which is put into our hands, but if they can give us the main lines along which we can proceed to run down and throw into a certain group any given kind of apple, then we shall go away as much refreshed as if we had eaten it.

There is a tendency to talk at length about a subject in which one is interested. I will resist that tendency, because I would much rather listen to men wiser than myself, and I call on Mr. BUNYARD, worthy son of a worthy father, to address you on a subject which he has made particularly his own.

E. A. BUNYARD, F.L.S.

THE need for a systematic classification of Apples and Pears has led to many attempts, but up to the present none has gained general acceptance. While botanists have reached some international basis of agreement Pomology is in the pre-Linnean stage, a vast mass of species and varieties but no genera or orders. Of the various attempts which have been previously made for Apples, I described the most important

in this JOURNAL in 1916, and it will not be necessary to traverse this ground again. Each of these systems has, or had, adherents in its own country, but none has been internationally accepted.

Must we conclude from this that no such system is possible ? Is there no grouping, artificial or natural, which will be valid for fruits of all countries ? To answer this question it is, I think, desirable to go back to our fruit trees and re-examine the characters on which any grouping must be based ; to investigate, however, distasteful it may be, the basis of our pomological faith.

As descriptive pomologists we are forced to deal rather freely with adjectives and adverbs of quantity and intensity, and I propose to inquire if more accurate measurement of certain characters is possible and if so of utility.

We have no exact knowledge of the species which have come together to produce the extraordinary complex modern apple, but we can dimly see certain natural groups which are probably indications of specific origin. The 'Reinettes' among which lie our best flavoured Apples ; the flavourless green or striped Apples, probably of Northern origin ; and the so-called Russian group, which, though probably known in Roman days, are of quite recent introduction to Western Europe and America, are the three main natural groups of Apples. In Pears is the downy-leaved, large-flowered group into which Catillac and Chalk fall, probably of Central European origin ; those of Western and Central Europe, and the best flavoured varieties which I imagine descend from the species of Western Asia.

Some centuries of cross-breeding and selection have so intermingled these putative parents that it would seem as hard to find a pure descendant as one of the uncontaminated "Nordic" race.

There may easily be some 10,000 Apples and as many Pears existing in cultivation to-day, and it is certain that some thousands of Pears and Apples have been named and described in Western Europe alone. The chances of a successful genetic classification such as the botanists are able to formulate are indeed remote, and we are therefore obliged to consider schemes based on shape, colour, season, flavour, etc., of which many attempts are before us. After a long study of these systems, and an attempt or two to improve upon them, I am obliged to conclude that no system based solely upon the fruits of the Apple and Pear can give an accurate answer to the question, What is the name of this fruit ?

Many varieties are sufficiently well characterized to proclaim their identity at once to the experienced eye, but the systematic pomologist is haunted when determining a variety by the thought of the thousands of varieties he has not seen compared with the hundreds he may know.

I suggest, therefore, that any key or classification to be of universal use must combine the tree characters with those of the fruit, and at the end of this paper I shall put forward such a scheme.

I may say at once that I greatly doubt if it is possible to make any grouping or key which will enable the inexperienced to run down a

fruit with, let us say, the accuracy that he can identify a postage stamp. Border-line cases are only too common. I think, however, that it is worth while trying once again to formulate a scheme, even if it be not absolutely water-tight. If we can make the approach more easy to nine-tenths of our fruits of any given kind it will have been helpful and worth while.

The Classification of Apples.

In dealing with the fruit and its characters we need not here devote space to emphasizing the great diversity of form, size and colour which every variety may show. We are agreed that certain fruits may be called large and others small, that certain are red, whole coloured or striped, and in assessing such characters we choose an average sample, throwing out the extremes.

I propose, therefore, to consider now the various parts of the fruit, tree, and flower which we use as determining characters and to make some attempt to estimate their relative value.

At a casual glance so much variation presents itself that such an attempt seems almost worthless. We must, however, consider averages rather than units. We are all agreed that 'Bramley's Seedling' is a large Apple, and 'Worcester Pearmain' a smaller one. It is quite possible to produce fruits which contradict this, but this does not invalidate the general proposition.

I propose, therefore, to submit average measurements and in some cases relative ones, and we shall find, I think, as a general rule, that in any dozen cases by throwing out the two largest and the two smallest, the remaining eight will show a certain constancy, using the word in its botanical rather than its mathematical sense.

The fruit which has been so far the basis of all classifications or keys in Apples and Pears, is, I think, the most variable of all the parts of the tree.

No systematic pomologist, so far as I have found, has yet recognized the great variation in form which the central apple of the truss, the so-called "king fruit," always shows. When the flowers are examined the stem will be seen to be much shorter and this character remains throughout the development of this fruit. Allied with this is a more shallow cavity and a definitely higher fruit. A little experience will enable these king fruits to be recognized in a general sample and they should be thrown out in any selection of average specimens equal with the extremes of size.

There is also another type of fruit in which the lateral measurements are exaggerated in the same way as the vertical ones in the king fruit. The width here is greatly increased from the normal and the eye and basin much widened and malformed. In these the usual eye formation is changed. If normally closed it becomes open. The tube is also greatly widened and often deepened. These fruits, so far as I have observed, are those which come from the lowest part of the flower truss, the stem is usually abnormally long and they are

in effect, as it were, the opposites of the king fruits. I think that they are usually produced when all the fruits above fail to set and the whole of the nourishment usually divided among several young fruits is concentrated into this individual. If, therefore, after a selection of twelve average fruits we throw out two with the shortest and two with the longest stems we shall usually get rid of these abnormal specimens.

Internal Characters of the Apples.

In fig. 9 the vertical measurements of 12 fruits of 'Annie Elizabeth' taken at random are given. Starting from the crown the first measurement is from thence to the base of the calyx leaves, which give a firm

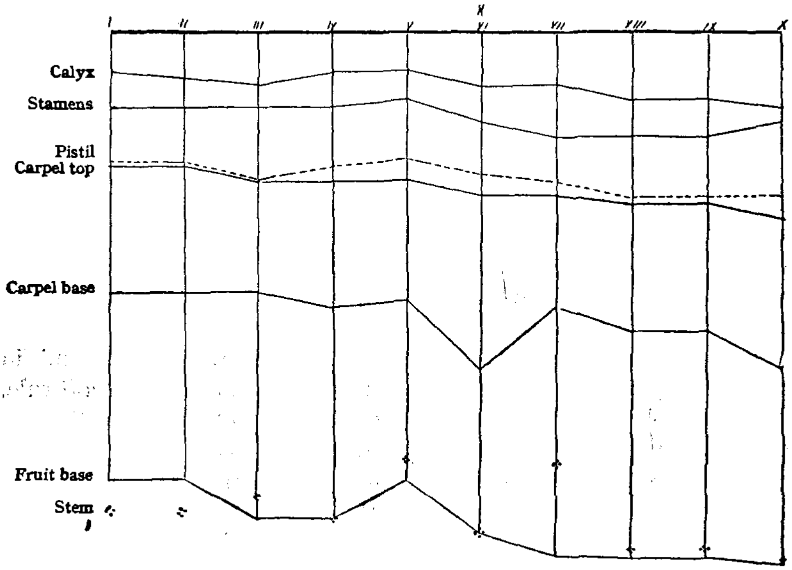

FIG. 9.—MEASUREMENTS OF INTERNAL STRUCTURES OF A SERIES OF APPLE 'ANNIE ELIZABETH' TAKEN AT RANDOM.

point to measure to. The second show the position of the stamens. From there to the base of the pistil gives the tube depth. The next point is the top of the carpel, or core, and from there to its base, which gives the position of the carpels whether basal, above the middle line, or central.

The top of the stem gives the depth of the cavity and the lowest point is the base of the fruit. The four dots finally show the position of the end of the stem. The gradual fall of the curves of course has no significance; by chance the largest fruits were measured last.

In making such measurements certain technical difficulties arise. The base of the calyx, for instance, is a sharp and defined point, as is the base of the pistil. The limit of the carpel or core is not always easy to estimate accurately. In cases when the carpel is elliptical the top and base often fade into a vague union with other tissues, making definite measurements difficult. In cases where the carpel is round or

obovate the widest point is taken where measurement is most accurate. The insertion of the stem, giving the depth of the basin, is taken at the point where the brown woody tissue of the stem ceases and the green fibre of the vessels begins.

In general it will be seen that the various organs occupy positions relatively the same in the large or smaller fruits; the carpel, for instance, in 'Annie Elizabeth' preserves its place slightly above the centre.

As all measurements given hereafter are in millimetres the usual mm. will be omitted.

The calyx or eye varies here from 5 in Nos. I and IV to 10 in No. X, and the pistil follows the same curve. The greatest variation is seen in No. VI, where the carpel is of an abnormal depth, showing that this is a "king" fruit. Had this fruit been omitted from the series it will be seen that the curves would have followed closely the vertical measurements of the fruits.

The most constant measurement is that of carpel breadth.* This, I think, is a general rule, but greater accuracy of measurements also comes in as a factor, the two definite lines inside and outside of the carpel being more clearly defined than those of the top and base.

To judge whether a fruit is normal or not the width measurements have also to be considered. In the chosen examples of 'Annie Elizabeth' the fruit breadth varies from 72 to 85 and the carpel breadth from 10 to 12. In shape the carpel shows much variation in this variety, being oblate, ovate, or in No. VI, the *king fruit*, elliptical.

The position of the stamens varies from 9 to 15 below the crown of the fruit, becoming deeper generally with the increase of the depth of the fruit, but not regularly so, as in Nos. II and IV.

The pistil base which gives the depth of the tube varies from 17 to 23.

The length of the stem shows considerable variation even when the king fruit, No. VI, is excluded, being sometimes protruded from the cavity and often shorter.

Fig. 10 shows a series of 'Clark's Seedling' again taken at random. Here No. V is the king fruit, having the elliptical carpel usually associated with this form. No. VI is one of the unusually broad type of fruit and this shows the 'Blenheim' type of eye and has an unusually broad tube, 5 mm. No. VIII is also abnormal in eye and tube. No. III is another abnormal, the basin flat with numerous bosses or mammae at the base. This character is, I think, usually associated with a check in growth at an early period, such as an aphis attack might cause. In general the carpel curve, as in 'Annie Elizabeth,' follows the curve of fruit size. The measurements of carpel breadth show a range of 9 to 15; Nos. II and X, both 68 wide, having carpels of 9 and 14 breadth respectively.

The most conspicuous point of this series is the great variation in tube depth shown by the line of the pistil base. No. I is 13 below

* For this purpose only one leaf of the carpel is measured so that irregularities of the central cavity (axile or not) can be avoided.

the sepal; No. III, 8; No. IX, 14. The last named had an exceptionally wide tube and a non-typical carpel.

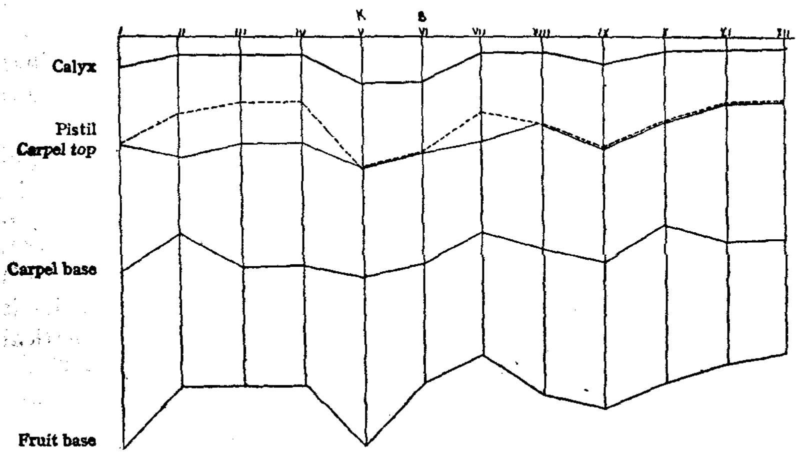

FIG. 10.—MEASUREMENTS OF APPLE 'CLARK'S SEEDLING,' DETAILS AS IN FIG. 9.

In Fig. 11, 'Norman's Pippin,' we come to an apple of the Reinette group and I find that fruits of this class are generally more regular in internal dimensions. The depth of the eye, it will be seen, is constant,

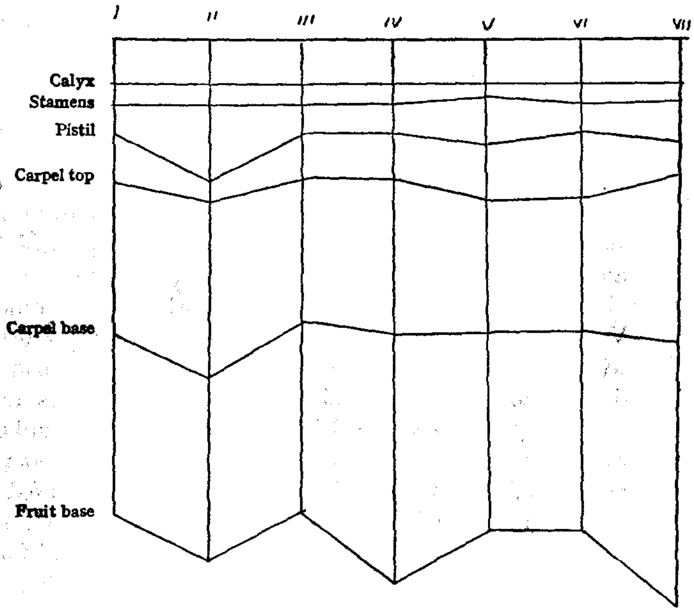

FIG. 11.—MEASUREMENTS OF APPLE 'NORMAN'S PIPPIN,' DETAILS AS IN FIG. 9.

in spite of variation in fruit size, and, with the exception of No. V, the stamen position in the tube. The depth of the tube is from 10 to 11, if we except No. II, which is obviously a king fruit from its deep carpel and short stem. The other curves follow very nearly the depth of the

fruit. Carpel width varies from 10 to 15. As in the previous series the carpel preserves very nearly its relative position in the various sizes.

Fig. 12 gives similar curves for 'Baumann's Reinette.' No. VII is here the king fruit, showing a lowered position for all points and the deep carpel. No. III is probably a king, though externally it did not show the usual characters. The width measurements show a fairly

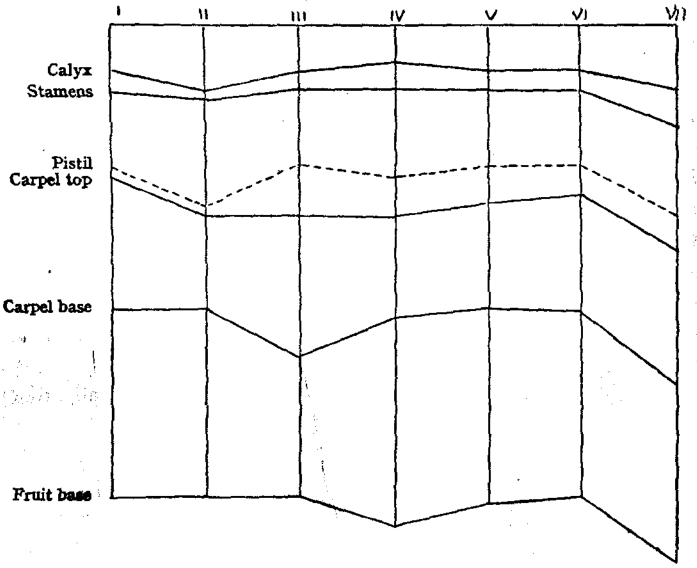

FIG. 12.—MEASUREMENTS OF APPLE 'BAUMANN'S REINETTE,' DETAILS AS IN FIG. 9.

constant carpel breadth, and omitting the king fruit No. VII, and the very broad No. VI, the variation is from 9 to 11.

A similar series of 10 'Lane's Prince Albert,' not here illustrated, shows similar curves, but is of interest as the carpel breadth is always 15, with one exception which is 13. The narrowest fruit was 60 with carpel 15, and the broadest 79 with the same carpel measurements. This may be compared with 'Annie Elizabeth,' where the broadest fruits 85 had carpel breadths of 11 and 12.

Many hundred similar measurements have been taken and I must ask you to take them on trust, as you must indeed my measurements.

A few examples of the relation of carpel breadth to fruit breadth may, however, be of interest in emphasizing this point.

	Nos. 1	2	3	4	5	6
Bramley's Seedling:						
Width of fruit	81	87	87	90	100	87
,, ,, carpel	8	9	12	10	9	12
Lord Derby:						
Width of fruit	81	81	75	81	81	75
,, ,, carpel	13	10	12	10	12	13
Alfriston:						
Width of fruit	75	78	75	87	87	75
,, ,, carpel	10	10	8	9	8	10

	Nos. 1	2	3	4	5	6
Worcester Pearmain :						
Width of fruit . . .	62	62	66	62	62	62
,, ,, carpel . .	10	10	11	10	8	10
Golden Spire :						
Width of fruit . . .	67	59	59	56	59	62
,, ,, carpel . .	7	7	8	7	9	10
Newton Wonder :						
Width of fruit . . .	84	72	75	78	81	81
,, ,, carpel . .	12	12	10	10	10	12

In the above there is some variation, but it is variation within a limit. If we compare two easily confused fruits, 'Alfriston' and 'Lord Derby,' we find the carpel width of the latter varies from 10 to 13 and the former from 8 to 10.

This is, of course, only another way, and perhaps a tedious one, of saying that one fruit has a larger core than another, a fact already known. I submit, however, it is of value to have a definite average measurement in place of such words as "fairly" or "moderately" large, "rather small," etc. To state that the carpel of 'Alfriston' varies 3 millimetres above 10 and 'Lord Derby' 2 below it is an advance in exactitude.

The other characters of the Apple may now be briefly discussed.

The Eye.

The characters used by Hogg and other pomologists in regard to the eye are valuable and in some varieties constant—if the exceptions as presented in the very broad fruits are omitted as noted above. The larger the variety the more irregular is the eye. The 'Reinettes' and 'Russets' maintain more even shape and are generally more constant in all characters than the 'Rambour' class.

The position of the stamens which Hogg made the base of his classification can be studied in figs. 9 to 12. In general this character is fairly constant in most varieties, quite constant in a few.

It is, however, impossible, I think, to use this point as a dividing line in classification successfully. The stamens are difficult to see, the tube is very subject to malformations and insects often make it a home and bring exact measurement here to disaster. In any case to make such minute differences, often one of millimetres, a dividing point early in any scheme of classification has obvious dangers. The depth of the tube is an excellent determining character for many fruits, but HOGG's division into "Conical" and "Funnel" shaped leads in practice to too many debatable cases. I suggest that the description of the depth is important and valuable and sometimes the breadth, and prefer to class them for preliminary classificatory purposes as shallow, medium, deep and narrow, deep and broad.

Core Lines.

American pomologists have used the vascular bundles which run up to about the level of the stamens as diagnostic characters. I find

them not very constant or reliable and should exclude them in all but full descriptions.

" *Truelles Line.*"—This line, which delimits the core area and shows plainly in many cider fruits when cut transversely, was used by TRUELLE as a diagnostic character. I had hoped to find it of use in our table fruits, but have not done so. It is extremely indistinct and in many cases absent or useless for the purposes of a key or classification.

The Seeds.

The colour of the seeds is useful in some cases as, for instance, the light brown colour in ' Golden Noble ' and many others of this group.

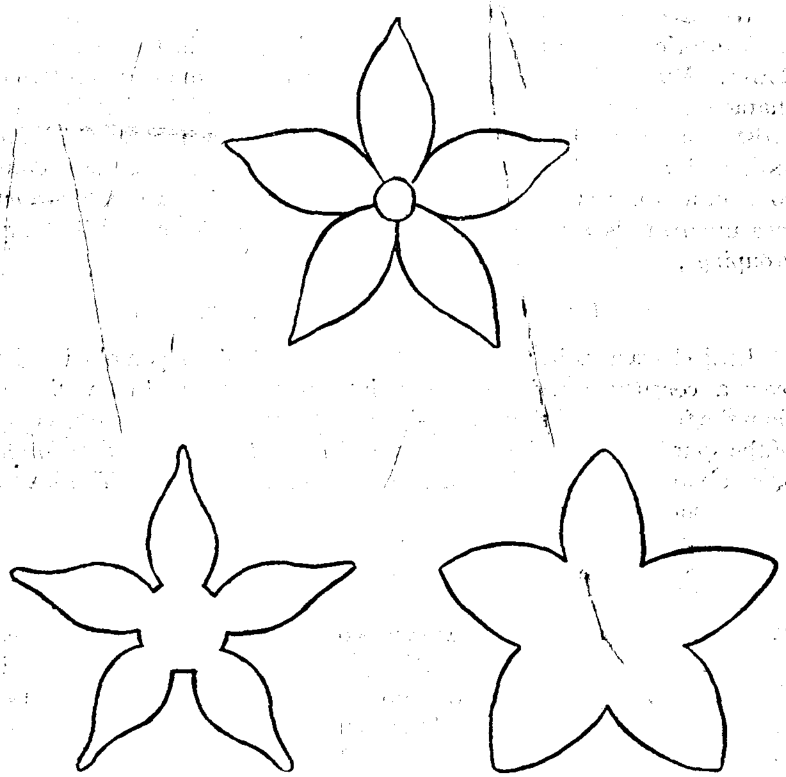

FIG. 13.—TOP, CORE AXILE, CELLS CLOSED. LEFT, CORE AXILE, CELLS OPEN. RIGHT, CORE ABAXILE.

Several varieties show a distinction of colour when opened, which fades in a few minutes to a uniform grey-brown. This is, therefore, a character of limited utility. Seed size is notable in some varieties, but does not often serve to separate similar fruits, and as the measurement is a minute and difficult process I reject it in any scheme of preliminary groupings, though a useful point in the full description, or as a special character in a few varieties.

Of the internal characters of the Apple there now remain the

characters of the carpel or core as viewed in lateral section. HOGG proposed to use them as a main dividing character in his key, and his divisions axile, abaxile are shown in fig. 13. This character is subject, in my opinion, to too much variation to be so used. Even if we discard the king and the broad fruits above described we find that Apples of similar class tend to have cores similarly formed. The 'Calvilles,' for instance, all have open cells and abaxile cores, the 'Reinettes' and 'Russets' similarly are nearly all axile and closed. Its value as a separating character in HOGG'S Analytical Key depended upon his previous divisions into stamen classes. If, as I think, this scheme is not practically useful the use of the axile, or non-axile carpel, must be relegated to a descriptive character, not a classificatory one.

We have now dealt with the internal characters of the Apple with the exception of the pistil, which will be discussed in treating of the flower. My conclusion on this subject is that we cannot from internal characters take any characters sufficiently stable to form from them a satisfactory key. For this purpose we must take characters which are more easily recognized for our main groups. The internal characters come in usefully as secondary and confirmatory points and their exact measurements is a useful aid, when we have made our preliminary groupings.

LEAF CHARACTERS IN THE APPLE.

Leaf characters in the Apple have been noted by pomologists for over a century and in certain points they present less variation than the fruit. Leaf shape and size vary very considerably, especially in the spur leaves; owing to their position on the branches these often grow abnormally long in an attempt to reach the light. The leaves on the shoots being more favourably placed for light show greater regularity in shape. Both, however, are constant in pose, a point which I emphasized in my Handbook of Fruits, vol. i, 1920. I then proposed certain terms to describe the different poses the leaf assumes. When the leaf is held up at an angle of 45° or so, it is *upheld*, when held out at a right angle, *outheld*, and when it hangs down, it is *down-held*. Spur leaves are often so placed that they cannot express their proper character, but when open to light and free to grow naturally this character is very constant and one of the first points that strike the eye and give individuality to a variety.

The blade of the leaf may be held flat, its edges may be folded upward, and the margins may be waved; all of which give a characteristic appearance to the tree. Adding these characters to that of leaf pose we get such terms as *outheld, up-folded*; *down-held, flat*; *down-held, up-folded*, etc., all of which I think can be easily understood.

We now come to a point of some difficulty—namely, the relation of the shoot leaves to the spur leaves. What characters have they in common? I cannot lay down yet any rule in this matter, but a few facts are evident. In shape they have little in common, in pose they have much. The marginal serration will be considered later.

Leaf Shape.

This is a constant and good character so far as shoot leaves are concerned. The long tapering leaves of a 'Brownlees' Russet' are conspicuous even from a distance and the round leaves of 'Blenheim Orange' equally so. A marked and regular feature also is the point at the apex of the leaf, which may be long and slender as in 'Beauty of Bath' or blunt and thick as in 'Stone's.' The length of the leaf stem is also a useful feature, but it does not vary enough usually to make it of much value in classification. Occasionally it is of critical value, as in the very short leaf stem of 'Blenheim Orange' compared to the much longer one of 'Orleans Reinette': a useful point in separating two fruits otherwise very similar in leaf and fruit. Leaf colour is sufficiently obvious and strikes the eye first of all characters. It is very constant in most cases, but here again has not enough range to be of use in classification. We can easily distinguish the grey-green of 'Lane's Prince Albert' from the black-green of 'Washington,' but in between there are too many intermediate varieties not easily distinguished.

Leaf Serration.

Here we come to one of the most variable of leaf characters and at first sight, and even at second, it seems impossible to reduce any order

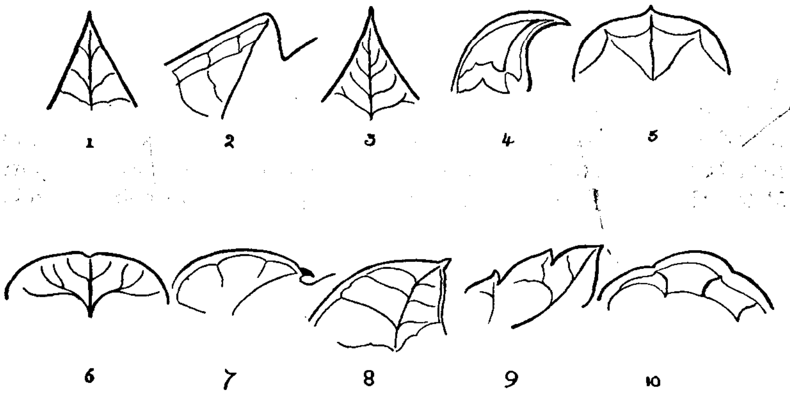

FIG. 14.—DIAGRAMMATIC SKETCHES OF VARIOUS FORMS OF SERRATION.
(1) Serrate; (2) Unequal Serrate; (3) Incurved Serrate; (4) Inclined Serrate; (5) Domed Serrate; (6) Crenate; (7) Inclined Crenate; (8) Curved Serrate; (9) Tri-Serrate; (10) Tri-Crenate.

or scheme into numerous fantasies which are played upon the serrate (pointed) and the crenate (rounded) themes. Differences, so obvious to the eye, vanish when we endeavour to translate them into words. I present an attempt to devise a nomenclature for the various types realizing fully its inadequacy in many cases, and the remarks here made will also apply to Pears so far as first principles are concerned.

The simple and true serrate, or saw-like point, is shown at fig. 14 (1). This equal-sided serration is rare, more common is (2). I call

these *equal* and *unequal* serration. When the serration is incurved on each side instead of straight (3), it will be called incurved serrate. When this shape is bent over as in (4)—inclined serrate. When the outline of the serration is arched as in (5) it is domed serrate. A variation in (4), inclined serrate, is found when the short side is straight, or nearly so—see (8). This I call curved serrate. The transition from serrate to crenate is gradual. When (5), domed serrate, is very shallow it becomes crenate—see (6). Another form of crenation is (7), where the top of the lobe is as it were bent right over, the small tip thorn showing in the depression instead of at the top as in domed serrate. In general we may define serrate as any point which projects above the general level, and this point is usually tipped by a small tooth. When crenate the point or thorn is in the valley between two hills, if I may so phrase it. Running one's finger along the margin no sharp points are felt in the crenate types, with the exception of the shallow forms of rounded serrate.

In general, Apples play variations on the serrate, and Pears on the crenate themes. 'Cox's Pomona,' however, is a true crenate, resembling closely (7), fig. 14. The small spines which at one time tip all serrations are sometimes retained and more often they fall when the leaf is adult. The point from which they proceeded is easily discernible as it is always led up to by a small vein, and when the serration is inclined the vein is no longer in the centre, as in (1) and (5), but unequally divides the serration, as in (4), (7) and (8).

We will now deal with Apple leaves, leaving Pears for later consideration. If any leaf is carefully examined it will be seen that the serration varies considerably from the base to the top, and I find that it is the top half of the leaf, about the shoulder, where the most regular forms are shown, and these I suggest as typical for descriptive purposes. Below this point the serrations have the appearance of being stretched out on the lower side. The equal serrate, for instance, below the centre of the leaf would become unequal.

The most outstanding character of a serration is, of course, its depth: compare, for example, 'Peasgood's Nonsuch' and 'Belle de Pontoise.' The depth of these serrations is quite capable of measurement. A very common variation in Apples is where a main point has several lower peaks making it bi- or tri-serrate (see fig. 14 (9)). This is a good character for many varieties and the lowest valleys in such cases can be measured. Tri-crenate, as (10), is also found.

It may perhaps be considered that I have laboured this point of leaf serration to an undue degree, but I think that such detail is worth while. The old expressions, such as "rather coarsely serrate," lead to a very vague impression. Fine and perplexing as the intergrades often are, it will be seen under my proposed scheme of classification which follows that more often than not the critical characters are far apart in similar varieties and for practical purposes the difficulties do not often arise. When we find two varieties of very similar serration we shall usually be able to select some other distinct and critical character of the leaf or flower which will separate them easily.

The Stipules.

The stipules found at the base of the leaf stalk on the shoot leaf are of great assistance in diagnosing varieties. Their variation is much less than any other part of the leaf, pose perhaps excepted, and their accurate measurement useful and easy to perform. The main cause of variation in size is, I think, due to some damage to the leaf in the young stage and in such cases they will grow beyond the normal. If the normal growth of the shoot is arrested they grow to abnormal size.

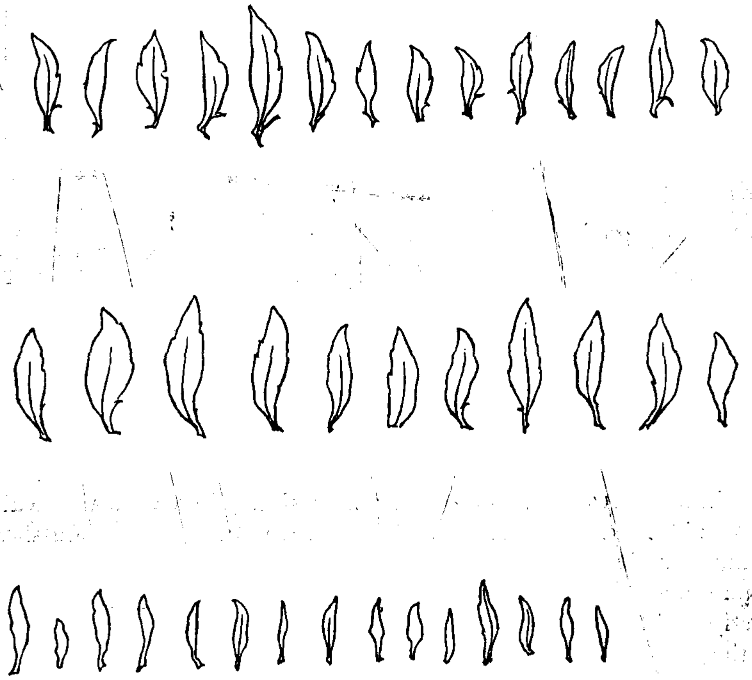

FIG. 15.—STIPULES TAKEN AT RANDOM TO SHOW VARIATION IN SIZE. Top, 'Newton Wonder'; middle, 'Red Ribbed Greening'; bottom, 'Hollandbury.'

Such cases are easily seen, the shortened internodes of the shoot showing that some check has been experienced.

The range of variation in one variety is shown at fig. 15, when were gathered to show this point the largest and the smallest that could be found. This method over-stresses their variation as the extremes are unduly represented. On looking at half a dozen shoots one can easily determine the normal and they fall in with my rule of rejecting extremes very well. The main bulk will be found to be remarkably constant. In size and shape they vary from the mere thread-like as in 'Ellison's Orange,' width 1½, length 9, up to the large and leaf-like as in 'Red Ribbed Greening,' width 6, length 22. In fig. 16 I show a selection and we can note the difference, for example, between 'Cox's Orange' (7) and 'Laxton's Superb' (8), between 'Yorkshire Beauty' (2) and 'Norfolk Beauty' (3), two pairs of Apples

easily confused when the fruit alone is studied. The smallest thread-like stipules, as 'Old Nonpareil' (4), usually fall very quickly; the more leafy, as in 'Bietigheimer' or 'King of Tompkins County,' usually last much longer, often falling with the leaf in autumn. In shape we may distinguish the regular oval as in 'Cox's Orange' and 'Laxton's Superb,' the irregular where the apex twists to left or right. The larger forms are usually serrated as in (9) and (10) and also in (6). The small spur near the base as in 'Bietigheimer' is usually constant. In 'Norfolk Beauty' it is present but minute. It will be seen that the stipule is very easily measured and its variation in length and breadth preserves very nearly the relative proportions in larger or smaller specimens. On very strong shoots the stipules, like the leaves, are larger, on weak laterals always smaller. I find that there is no general

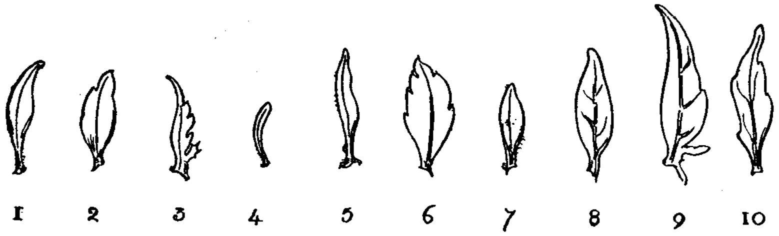

FIG. 16.—APPLE STIPULES.

(1) 'New Hawthornden'; (2) 'Yorkshire Beauty'; (3) 'Norfolk Beauty'; (4) 'Old Nonpareil'; (5) 'Catshead Codlin'; (6) 'Mother'; (7) 'Cox's Orange'; (8) 'Laxton's Superb'; (9) 'Bietigheimer'; (10) 'King of Tompkins County.'

correlation between stipule size and fruit size. Were it so their value as an aid to identification would be much reduced. The 'Catshead Codlin' for instance, one of our largest Apples, has a much smaller stipule than 'King of Tompkins County.' As an example of the value of stipule dimensions in naming a variety, I select the following Apples of the Cox group. It will be seen that they are a very material aid in separating these similar varieties. Width is given first, then length.

St. Everard	3 × 9	Scarlet Nonpareil	2 × 8
Ellison's Orange	1½ × 9	Laxton's Superb	4 × 14
Sir J. Thornycroft	2 × 11	St. Cecilia	3 × 16
Cox's Orange	3 × 10	Margil	2 × 12

It may be pointed out to those who have not made close measurements, that the difference of a millimetre, or even a half, though it looks small on paper, is very appreciable to the eye. The length is a little difficult to estimate finely owing to the question which arises sometimes where exactly the base of the stipule begins.

The Flower.

In a paper read before this Society in 1912, entitled The Flowers of Apples and their aid in identifying Varieties, I drew attention to the neglect of the study of this organ in this country. Since that time I have been accumulating notes and making comparisons with trees of different ages and in different environments, with the result

that I place the flower among the most constant of Apple and Pear characters and of the greatest importance in variety recognition.

The Time of Flowering.

This has been studied at Wisley and elsewhere, and while of some value diagnostically most varieties overlap to a great extent in flowering season and therefore the extremes only are of use for our purpose. It is useful to know whether a variety flowers early or late, but only a few naturally occupy the extremes. I therefore omit this character in my preliminary classification and reserve it for a note in the exceptional cases.

Petals: Colour, Shape and Size.

The petals of Apples show a remarkable range of size and a good deal in colour. The colour may be quickly fading as in 'White Trans-

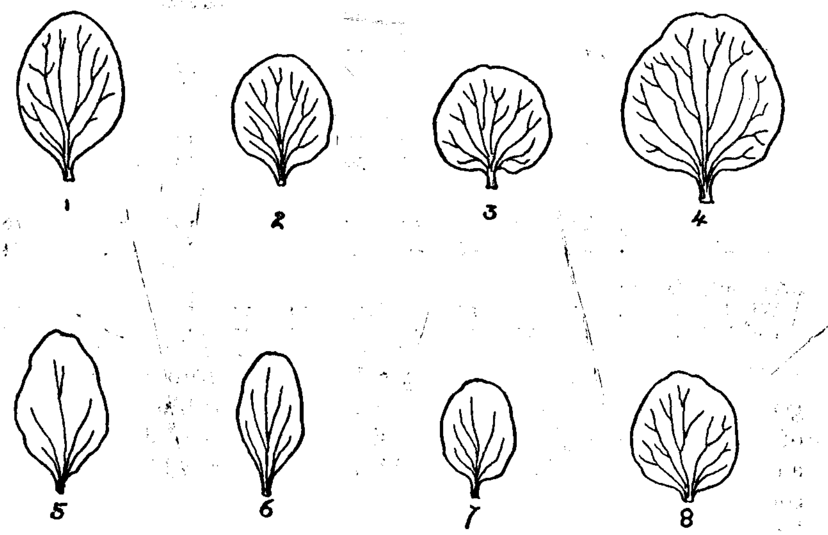

FIG. 17.—PETALS OF APPLES SHOWING RANGE OF FORM AND SIZE.
(1) 'Peasgood's Nonsuch'; (2) 'Clark's Seedling'; (3) 'Old Hawthornden'; (4) 'Gravenstein'; (5) 'Paroquet'; (6) 'Worcester Pearmain'; (7) 'St. Everard'; (8) 'William Crump.'

parent,' where the early pink tinge is soon lost, or it may be permanent as in 'Golden Spire,' where it is suffused throughout the whole of the petal and not a wash on the outside as in most. I do not find that these suffused flowers belong to any particular group of Apples. Besides 'Golden Spire' above mentioned, it is also seen in 'Old Nonpareil,' 'Annie Elizabeth,' 'New Northern Greening,' 'Histon Favourite' and 'King's Acre Pippin,' to mention a few from very different groups.

There seems to be no correlation between petal colour and fruit colour. As a general rule it is the green apples which have the brightest coloured flowers. Petal size, too, has a general correlation with fruit size, but there are some striking exceptions. One of the largest of all

is ' Nelson Codlin,' where the petals reach enormous proportions, 20 by 30 (width being given first), the fruit being of medium size. There are also several very small Apples, such as the ' Norfolk Stone Pippin,' the ' Nonpareil Russet ' and ' Rother Jungfernapfel,' where the breadth of the flower exceeds that of the fruit. In general, however, petal size follows fruit size.

In fig. 17 I give a few drawings of the more general forms assumed and they may be described as round, oval, ovate and obovate, with an approach in some to oblong. These forms are very regularly maintained. Variation in size of course occurs and some idea of the range will be gained from the following figures. It will be observed that some are more regular in height, others in width, but by excluding extremes we see a considerable approach to uniformity in those left.

White Nonpareil:												
Width	14	14	13	12	12	12	12	15	12	15	12	11
Height	23	21	20	20	20	22	20	21	20	20	20	20
Ross Nonpareil:												
Width	16	15	14	15	14	13	14	14	14	14	14	14
Height	20	18	17	18	19	16	17	17	17	20	17	18
Egremont Russet:												
Width		17	14	14	16	17	14	16	14	14	15	16
Height		25	22	22	25	30	24	24	22	20	25	25
Grimes' Golden:												
Width		17	17	16	17	17	16	17	16	17	17	16
Height		25	24	25	26	25	26	25	25	25	27	24
McIndoe's Russet:												
Width		15	15	15	16	14	14	14	15	16	15	15
Height		20	21	22	22	20	22	21	25	25	20	25

There is one character in the petal which seems to me to have a genetic significance, and that is the very thin, almost transparent petal of the Apples belonging to the Russian group. Coupled with this is a curious twist in it when opened which I can only roughly describe by comparing it to a propeller blade. In my notes I marked it down as "screw." There is often a tendency for the margin also to be cut or crinkled. ' Cardinal ' shows this special character among others and is a good representative of the Russian group.

In the measurements of petals I have made for my suggested system of classification I have given the breadth at the broadest part and the height. This gives a general idea at a glance of size and shape—whether round, for instance, 12 × 12 or oval 6 × 12. Such measurement does not of course indicate these ovate petals where the greatest width is at the base, nor take any account of the base of the petal, whether cordate or not, nor the length of the stem or pedicel. Such finer differences must be sought in a full description, my aim in the classification table being to give a rapid survey of outstanding characters. In general the petals of Apples are very constant in shape and colour and fairly constant in size. If we compare the variation here with that of the fruit, I consider the flower to be the least variable part of a fruit tree and its neglect by so many pomologists is to be regretted.

Bud Colour.

The colour of the unopened bud, as I pointed out in 1912, is a useful distinguishing feature for Apples. When about the size of a pea the colour can be easily seen, and it varies from a pale yellowish pink to a rich violet-red.

As an index of the range of colour in the unopened bud the following may be quoted. The numbers refer to KLINGSIECK'S Chart.

Pale Pink :

'Fearn's Pippin' 3 D., 'Alfriston' 21, 'Emperor Alexander' 21.

True Red :

'Lord Derby' 7, 'Hereford Pearmain' 7, 'Dutch Codlin' 3, 'Golden Knob' 3.

Violet-Red :

'Beauty of Kent' 577, 'Dredge's Fame' 576, 'Lord Grosvenor' 581, 'Duchess of Oldenburgh' 586.

In my preliminary classification table I make these rough classes of bud colour, Pale, Mid and Dark.

The Pistil.

In the paper previously referred to I discussed the value of the pistil as a distinguishing character and illustrated the various forms it assumes. In some we find the styles or separate branches of the pistil separate to their base, in others they are united into a column of varying length, sometimes to half the length of the entire pistil. There is also in some a certain amount of down or wool, either at the base, at the junction, or in some (as in 'Winter Queening') throughout the whole organ. R. T. PEARL, in commenting on this in the Journal of Pomology, vol. x, No. 1, 1932, points out that the central or king flower varies considerably and that conditions of growth affect development. With this I agree, but I submit that if we do not ask of the pistil a greater degree of accuracy than from other characters we can find, after rejecting extremes, sufficient uniformity to be worth recording and to be of value as separating characters. I find that all varieties where the styles are free to the base are downy at the base, so that for purposes of classification "down" need not be specified in these cases. When the styles are united there is usually some slight down at the junction, but not always: a few instances of entirely smooth pistils are found. The few varieties where the styles are hairy throughout are, in my experience, very constant. The relative length of pistil and stamens I find to be valuable and in most cases quite as constant as other characters discussed above. If the styles can be seen plainly protruding from the stamens over a number of flowers, this I describe as "Pistil longer"; if they do not protrude, for my table I call it "equal"—whether shorter or not.

The length of the style in different varieties is shown in fig. 18. We can compare the length of 'Golden Reinette' with that of 'New

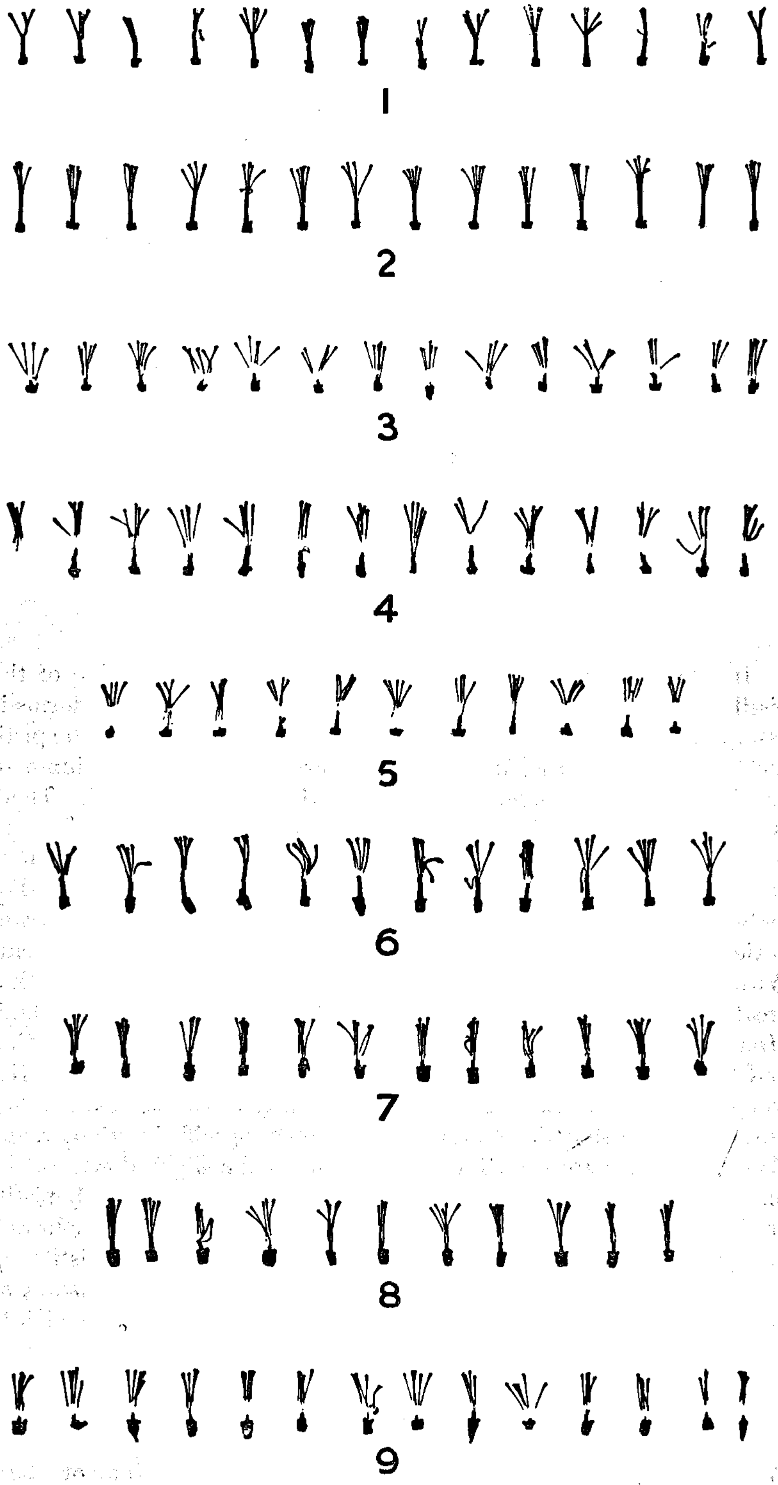

FIG. 18.—STYLES OF APPLE FLOWERS.
Each line represents a single variety.

Hawthornden ' to see this variation. I agree that the pistil characters are variable (what tree characters are not !), but after some twenty years of observation and comparison of my own specimens with these from Wisley and elsewhere, I think they should be included in any scheme of classification. On the more vexed question of their state when dried up in the fruit I do not like to speak so confidently. The natural shrinkage shortens them markedly, but the presence or absence of down is not affected. The downy styles as in ' Winter Queening ' retain their down. In a few, such as ' Pitmaston Pine Apple,' the column at its base becomes fleshy and takes on a yellow colour which makes it easily seen, but this peculiar character is I think rare.

Conclusions.

Having now discussed the fruit, leaf and flower it remains to sum up the detail given and to suggest a method by which it may be best used in the recognition of fruit. There are no characters unfortunately for our purpose that are not subject to some degree of variation, and as we are used to assessing what is the average size of a fruit in a given sample, so must we do in other characters. We cannot expect mathematical accuracy in so plastic an organism as a plant, and if I am told that pistil or other measurements are of little value on this account, I submit that we easily recognize an average measurement by rejecting extremes. Even a quick glance at several shoots will establish quite easily the average size and serration of the leaf and its stipules. We shall, I think, agree that some characters are obviously more variable than others and any key or classification should proceed from the least variable. In this fact lies, I think, the failure of any artificial system, such as WARDER'S in Apples and CHASSET'S in Pears. Based in both cases on the form of the fruit they choose a character which is very variable. Similarly HOGG'S artificial system, based upon tube length, stamen position and carpel characters, has not proved acceptable. Starting from minute detail it led one frequently astray and in any case grouped together varieties which are obviously dissimilar, a fault common of course to many artificial keys. I submit that by proceeding from well-defined groups and from thence to certain marked classes within the group and lastly to the minutiæ of differences between varieties we shall follow a course more natural to the human mind. At a glance the Codlin class can be distinguished from the Reinette or Russet, we can next divide the Codlins, let us say, according to shape or season and finally get down to a small number to which the fruit we desire to name must belong. This was the principle of DIEL-LUCAS system and as I suggested in my lecture on the History of the Classification of Apples (JOURNAL R.H.S., **42**, 1916) it is on these lines that future progress must be made. In my Handbook of Fruits I made a rough division into families and then subdivided them into seasons and various shapes. I now think that I placed too much emphasis on form—oval—round—flat, etc., as these so frequently run into each

other. In my new attempt I wish to insist as well upon the outline as seen from above, that is upon the regularity or irregularity of the

Classification Suggested for the Cox Group.

Season.	Fruit.			Leaf.				Flower.			Special Character.
	Eye.	Tube.	Core.	Pose.	Blade.	Margin.	Stipule.	Bud.	Petal.	Pistil.	
Early :											
St. Everard	C	M	$\frac{13}{15}$	U	F	C-S	$\frac{3}{9}$		$\frac{14}{23}$		Earliest Apple with Cox flavour.
Ellison's Orange	C	M	$\frac{8}{15}$	U	F	C	$\frac{1\frac{1}{2}}{9}$				Long stem, faint aniseed flavour.
Sir J. Thornycroft	C			O	P	C	$\frac{2}{11}$	M		E	Upright. Leaf finely crenate.
Mid :											
Cox's Orange	C	M	$\frac{10}{14}$	U	F	C	$\frac{3}{10}$	M	$\frac{14}{20}$	L	Yellow flesh and flavour.
Gipsy King	O	M		U	P	C		P			Netted russet, long stem.
Ross Nonpareil	R	S	$\frac{12}{15}$	U	F	S	$\frac{1\frac{1}{2}}{7}$	D	$\frac{14}{24}$	L	Greenish flesh. Leaf irregularly serrated, often nearly entire.
Late :											
Scarlet Nonpareil	O	M		O	P	C	$\frac{2}{8}$	P	$\frac{14}{20}$	E	Long stem. Leaf long, pale.
Laxton's Superb	C	DN	$\frac{12}{20}$	O	P	S	$\frac{4}{14}$				Dull purple red. White flesh.
Margil	O	M	$\frac{11}{15}$	U	F	S	$\frac{2}{13}$	M	$\frac{12}{20}$	E	Yellow flesh, strong Cox flavour.

Classification Suggested for the King Group.

Season.	Fruit.			Leaf.				Flower.			Special Character.
	Eye.	Tube.	Core.	Pose.	Blade.	Margin.	Stipule.	Bud.	Petal.	Pistil.	
Early :											
Hitchin Pippin	C	S	$\frac{11}{20}$	U	F		$\frac{2}{11}$	P	$\frac{18}{25}$		Spreading growth. Extremely juicy.
Mid :											
King of the Pippins	O	DB	$\frac{10}{20}$	U	F	S	$\frac{2}{14}$	D		L	Upright, short jointed growth.
Christmas Pearmain	O	DB	$\frac{12}{25}$		F	S	$\frac{3}{14}$		$\frac{15}{22}$		Upright growth. Shallow basin.
Mabbott's Pearmain	C	S	$\frac{10}{17}$	U	F	C-S		P			Freckled grey russet.
Golden Reinette	O	DN	$\frac{11}{16}$	O	F	C-S		P	$\frac{13}{27}$	L	
Barnack Beauty	O			O	F	C-S	$\frac{3}{12}$		$\frac{17}{23}$		Approaching egg-shape.
Late :											
Easter Orange	C	M	$\frac{10}{20}$	O	F		$\frac{2}{11}$		$\frac{18}{30}$		Scaly russet, round stem.
Adam's Pearmain	O	M	$\frac{10}{17}$	O	P	S		P	$\frac{14}{24}$	L	Conical, often waisted. Dry flesh.

fruit due to the presence of ribs. In the basin, too, we have a character of much importance, a point which we note at a glance. The tyro would see the difference between a 'Golden Noble' and a 'Queen

Caroline ' once the ribbed basin of the former had been compared with the smooth saucer basin of the latter. Proceeding therefore on the general lines of my first attempt I now subdivide into families or groups choosing a well-known representative. Thus a family group will be made in the ' Reinette's,' having such well-defined varieties as ' Cox's Orange,' ' Blenheim ' or ' King of the Pippins ' as their types. I next desire to bring into the same vision some outstanding characters of the tree, flower or leaf, as accurate recognition is often impossible without such facts. There are of course certain characters so pre-eminent, for instance the flavour of ' Orleans Reinette,' that recognition by this alone would be possible blindfold. Such cases, however, are exceptional. It will be seen, however, I think, that most Apples have some outstanding feature which if it could be seen would settle at once any doubt ; the upright or weeping character of the tree or the colour of the flower for example. It is such characters we carry in our mind, not the scores of details of every variety which I presume no pomologist can memorize. Tested by such a scheme we can then refer to a fully detailed description. To the amateur who expects every expert to name his Apples or Pears with the facility that he himself could a playing card taken from a pack, it must again be emphasized that in the majority of cases this is quite impossible. Those who are anxious to have their fruit accurately named must take the trouble to dry a few flowers and leaves between blotting paper, present them with the fruit when it is ripe with such details as the age and habit of the tree, and its time of flowering in relation to known varieties. Only so can the naming of fruit leave the sphere of guess work and make an approach to accuracy.

I have added two examples of my proposal, the Cox and the King group. Though not quite complete in all details, there is, I think, sufficient matter to enable its main principle to be appreciated. I submit it to this Conference asking for criticism before embarking upon the larger task of working out the entire scheme. I do not for a moment imagine that such a selection of outstanding characters can enable exact determination of any fruit to be made; for this reference to a fully detailed description is indispensable.

I hope, however, that there may be some who agree that such a preliminary sorting out may facilitate the naming of Apples and Pears.

THE CLASSIFICATION OF PEARS.

The history of the classification of Pears, as that of Apples, begins in Germany in the late eighteenth century, MAYER, the author of the ' Pomona Franconica ' (1778), being the first to put forward a scheme based primarily upon flavour and flesh texture and secondly upon shape. A few years later MANGER proposed four main divisions: Apple-shaped, Pear-shaped, Pearl-shaped and Top-shaped, each divided into round, oval and flat sub-groups. SICKLER in 1794 followed with emphasis in the shape at eye and stem. CHRIST proposed for the first time three

classes based upon the season of ripening and two (rather curiously) on form and one on quality—whether cooking or not. A more important attempt was that of DIEL in 1801, who first made six groups based upon flesh texture; melting, crisp, half-juicy, etc., his second division on shape and the last upon season. In 1909 CHRIST made a new attempt where he followed DIEL in making his first classes according to shape, his second on season of ripening. LIEGEL (1826) inserted between the two groups a separation of shape: flat, round and long. DITTRICH, LUCAS and DOCHNAHL from 1839 to 1849 made new attempts, the last named endeavouring to establish the genetical origin of each and grouping them according to the species from which they had been derived. One cannot restrain a tribute to his courage. In 1857 JAHN proposed a system in which his first step was based upon the leaves, whether round, oval, lanceolate and so on. Each of these orders was then divided into seasonal classes, Summer, Autumn and Winter. As every student knows the leaves of Pears are remarkably diverse in shape, pose and general appearance and it was perhaps natural for JAHN living among his trees to take what is for him so striking a character for his main groups. In 1863 we have the first attempt by a Frenchman, WILLERMOZ, the erudite editor of the 'Pomologie de la France,' Lyon, 1863. Here again shape was made the first dividing line, the old classical French names being used. 'Bergamotte,' spherical; 'Besi,' egg-shaped; 'Bon Chrétien,' quince-shaped; 'Calebasse,' club-shaped; 'Colmar,' top-shaped; 'Doyennés,' barrel-shaped; 'Rousselets,' small fruits; 'St. Germain's,' pear-shaped. These group names have long been established in French pomology, but with the exception of 'Bergamotte' have never been much used in England.

Other systems have been proposed since 1863 but all have played variations on the same themes, no really original scheme has been put forward. In 1928 M. CHASSET, the Secretary of the French Pomological Society, produced a large folio of some 350 pages describing his system which is again based on first "apparent" dimensions. The distinction between apparent and real measurements is well known to pomologists.

Category 1. Fruits apparently of equal height and breadth.
,, 2. Breadth apparently exceeding height.
,, 3. Height exceeding breadth in ratio 1/10 to 4/10.
,, 4. Height exceeding this ratio.

The second division consists of various forms—oval, round, quince-shape, etc. Thirdly, season of ripening makes a division; fourthly, the colour of skin; fifthly, stem characters; sixthly, the nature of the stem, if fleshy or not; seventhly, the position of the stem on the fruit. Divisions 8 and 9 deal with flesh colour and flavour, and the last column 10 is for recording special characters. The bulk of the book is taken up with setting out all these probable classes whether representatives exist or not, and thus the work is bulky beyond its needs. The out-

standing originality here is the emphasis laid on the characters of the stem, whether fleshy or not, straight or curved, etc. When the matter was discussed many years ago at a conference in France it was pointed out that great variation in stem position, curvature and length was present in most varieties owing to the fact that the Pear flowers are in what is almost a raceme—that is, they do not like the Apple radiate from one centre but the stems spring from a centre " spindle " of some length. Should an upstanding flower set, the weight of the fruit naturally bends it over as it swells. A flower hanging below the spindle naturally hangs straight down. M. CHASSET was, however, confident that this was no serious objection to his scheme, and disregarded such variation. In any case his proposal is at the time of writing by far the most elaborate before us, but will not, I think, gain general acceptance for this very reason. To hunt through some three hundred pages for a determination would baffle all but the most industrious and leisured.

A rather remarkable feature is an entire neglect of the characters of eye and basin, two points easily seen and which give so much individuality to Pears and Apples. I propose in my own attempt to class the Pears as I have done the Apples into family groups where resemblance is obvious. The smooth green skins of ' Glou Morceau,' ' Beurré Six,' ' Beurré Bachelier,' 'Mme. Treyve,' etc., constitute a group which is easily separated from the rest. Then ' Louise Bonne ' may be taken as a typical family, the red flush and spots being characteristic. 'Durondeau,' 'Verulam,' 'Calebasse Grosse,' will serve as typical representatives of other groups. As other pomologists have found, I shall have to bring in the shape very early in my scheme, this will be the second dividing point. The remaining points will be set out as for Apples, bringing in characters of flower, leaf and tree on the same line. These characters will now be briefly discussed.

The Shape of the Fruit.

Anyone who has handled many Pears will recognize the large variation any variety will show in outline. The causes for this have not, so far as I know, been considered apart from the question of pollination, which in some cases has an influence in determining form. As in Apples fruits attain first of all their length and then put on weight in the lateral direction. This has, of course, the effect of making a top-shaped fruit more round and a pear-shaped one more oval when well-developed.

I find that the position of the flower on the " spindle " has also a large effect in producing certain forms. A central flower will produce a longer and more slender fruit than a lateral flower. This fact also influences the insertion of the stem. When a flower pointing upwards is set the young fruit at first points upwards also. As it gathers size it gradually bends over and at the insertion of the stem a bump of flesh appears which I suppose is a strengthening of the vascular tissue to support this strain. It will be noted that the outside, or sunny

side, of the fruit is nearly always larger than the shaded, in such fruit. The effect is, of course, emphasized in such varieties as have short stems. In longer-stemmed varieties the curve and strain is taken by the stem and in these I think the fruit is always more regular in form and does not show so often the bump of flesh on one side of the stem. There seems to be also a tendency in some varieties to set the central flower in preference to the others as we see in some Apples.

For these reasons we cannot lay much stress, I think, on stem characters and those of the cavity in Pears. One may find the stem in the same variety level with the surface, in a cavity, straight, curved and inserted at an angle.

The Basin and Eye.

These characters are more constant than those of stem and basin, and they give in many cases the distinctive appearance to the fruit as in Apples. The deep rounded basin of a 'Doyenné du Comice' is one of its easiest recognition marks.

The eye is in some varieties very constant in its shape and position of sepals. At one extreme reflexed and laid back as in 'Calebasse Bosc,' or 'Vicar of Winkfield,' or firmly closed as in 'Easter Beurre,' 'Idaho,' 'Napoleon,' etc. The open eye, however, is by far the most numerous class. In my suggested classification I note three positions, segments erect, reflexed and closed, dispensing with "open," which could apply to erect and reflexed segments. In fuller descriptions each sepal may be separate or united into a common ring or base, a very good character for some varieties. In some cases, as in the Pear 'Eyewood,' I have noted that the sepals are white from abundant hairs.

Internal Characters of Fruit.

No careful study has, to my knowledge, yet been made of the internal characters of the Pear. The core position is obviously variable in different varieties, being central in 'Beurré Delannoy,' 'Bergamotte Crassanne,' 'Bergamotte d'Esperen,' etc., and closer to the eye in 'Napoleon,' 'Conference,' 'Colmar d'Arenberg,' 'Beurré Sterckmanns.' The cells also vary from round to oval and are, I think, always closed. The direction they take is often a good character. Thus in 'Nouveau Poiteau' and 'Doyenné du Comice' they are vertical so that the seeds stand erect, in 'General Todleben,' 'Notaire Lepin' and 'Le Lectier' they are inclined outwards so that the seeds lean away from the central axis at an angle of 45 degrees. The position of the stamens varies as in the Apple.

The tube may be wide or narrow, and is usually cup-shaped above and from thence may descend in a very narrow tube for varying depths till the base of the pistil is reached. In 'Fondante de Charneu' and 'Beurré Superfin' it does not exceed 2, in 'Comice' 2–3, 'General Todleben' 3, 'Vicar of Winkfield' and 'André Desportes' 5, in 'Beurré Delannoy' and 'Beurré Diel' it reaches 10.

Owing to the stony cells with which this part is surrounded it is extremely difficult to make a section here, and in view of this it is not surprising that most pomologists have omitted to deal with this in Pears.

The Flower.

As in Apples there is no correlation in petal size with fruit size. The very small 'Chalk' Pear has petals 11 × 20, the large 'Marie Benoist' 7 × 12; 'Emile d'Heyst' 7 × 10, and the smaller 'Belle Julie' 12 × 17. In shape, too, I find no correlation; for example 'Idaho,' a very flat apple-shaped fruit, has curiously broad flattened

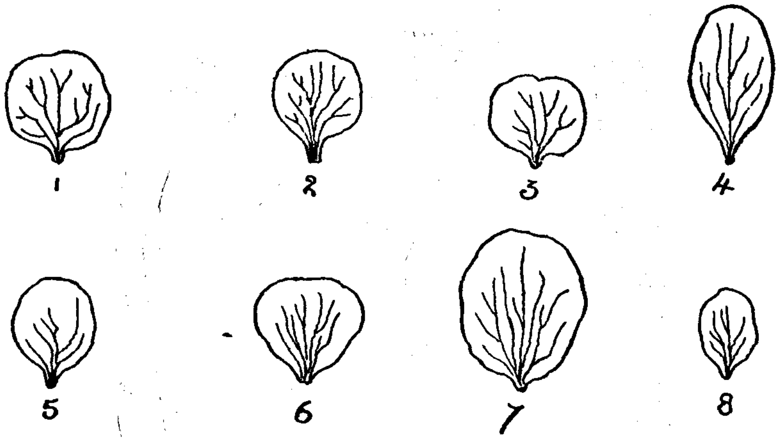

FIG. 19.—PETALS OF PEARS.

(1) 'Forelle'; (2) 'Louise Bonne'; (3) 'Idaho'; (4) 'Chalk'; (5) 'Souvenir de Congrès'; (6) 'Marguerite Marillat'; (7) 'Beurré Rance'; (8) 'Comte de Paris.'

petals 10 × 10, but 'Uvedale's St. Germain' has also a round petal, though larger—12 × 12. It must be observed that the height measurement includes the pedicel or stem of the petal, so that a petal apparently round may from its dimensions appear oval from the figures alone. I have found no way of evading this technical difficulty. Fig. 19 gives an illustration of some of the different shapes and sizes found. In Nos. 1 and 2 we can compare 'Forelle' and 'Louise Bonne,' two fruits easily confused, and in 5 and 6 'Souvenir de Congress' and 'Marguerite Marillat,' another pair. No. 4 'Chalk' and No. 8 'Comte de Paris' show variation in size very well.

The variation in petal size follows much the same range as in Apples as the following show :—

Passe Colmar :								
Width .	11	12	12	11	11	12	12	12
Height .	17	19	18	18	19	21	18	19
Calebasse Bosc :								
Width .	8	8	8	9	8	8	8	8
Height .	16	16	16	17	15	16	17	17

General Todleben :

Width .	11	11	11	11	12	11	10	11	
Height .	13	14	14	15	14	13	11	11	

Glou Morceau :

Width .	11	10	9	11	9	12	10	11	10	10
Height .	15	14	14	14	13	15	11	14	15	15

Owing to the very thin texture of Pear petals, and the difficulty of mounting them after drying without any folds or kinks, these measurements are a little more liable to error than Apples, but the figures, as in Apples, show, I think, that an average size is evident when the largest and smallest are omitted. By taking this average we can feel pretty sure that if the flower before us for determination has a petal measurement three or four millimetres above that of a certain variety it is not identical. A variation one above and one below nearly covers the range when the extremes are neglected and in some cases includes extremes. It is therefore of value, I think, to state that 'Calebasse Bosc' will have an average measurement of 8 × 16 and 'Glou Morceau' 11 × 14.

Bud Colour.

There are many Pears which show a pink tinge on the unexpanded bud, but as the great majority are white I do not think this a character which should rank early in any scheme of classification.

Pistil.

The pistil of the Pear shows no such diversity as that of the Apple, so far as my experience goes, but I have not yet given much time to this point. There is a decided variation in length and I think downiness, but closer investigation is required here. No pomologist has, I think, included this character in his descriptions.

Calyx.

The calyx lobes which later become the "eye" of the fruit are excellent characters; both in length and breadth they show great variation. It is interesting to see that these varieties in which the eye is a continuous ring and not in separate lobes show this character in the flower state. The pedicel of the flower which becomes the stem of the fruit is in a few varieties very constant, but owing to the fact, as above mentioned, that Pear flowers radiate from a main "spindle," variation in stem length, pose and insertion are in my view too variable to merit a place in any system and only valuable as a confirmatory character. Those fruits which are very constant in stem character are few and in such cases it forms an excellent character for a note.

The Leaf.

In shape the majority of Pears take up oval or lance-shaped form, some approach to oblong and others a long narrow strap form. In pose the terms used for Apples will describe them accurately, with the

addition of a form that occurs in a few cases, which will be called up-cupped. In this the edges of the leaves are not merely folded up but bent up all round so that a spoon-like form is given.

Leaf Margin.

In general the terms used for Apples will apply, but some forms as the true serrate are rare. Many are entire, having no teeth. As in Apples the leaves of the shoots nearly always show more emphasis in serration, an exuberance of drawing as it were which the spur leaves coming from older wood do not affect. In some cases the suppression is so great that the serration is almost lost so flattened out are the teeth. For this reason it is necessary to describe both spur and shoot leaf. In my preliminary tables I use the spur leaf which is always present where there is fruit. In some cases, as in 'Comte de Paris,' the teeth are flat or suppressed but the tip thorn remains. Such a leaf appears entire until examined with a glass and in most cases these thorns are unusually wide apart. We find much finer serration in the Pear than in the Apple, and usually a magnifying glass is necessary to distinguish the different types.

The serrations of Pears are in general more regular than those of Apple leaves, and may thus be measured with some accuracy. The following examples show the range, the figures giving the number of serrations in 20 millimetres :—

'Louise Bonne' 10, 'Doyenné du Comice' 9, 'Doyenné d'Etè' 11, 'Fertility' 17, 'Durondeau' 12, 'Belle Julie' 15, 'Bellisime d'Hiver' 12, 'Beurré Mortillet' 14, 'Grosse Calebasse' 8, 'Beurré d'Avalon' 8.

In some varieties the serrations are so indefinite as to be hardly measurable, to these the term "Rouletted" has been applied.

I have compared a large number of Pear leaves of the same variety grown in different places and on different stocks and find that leaf shape and serration is constant.

It will also, I think, be possible to use descriptive terms for the different forms of serrations as has been suggested for Apples.

Leaf Hair or Down.

Every grower of Pears must have noted the very dense hairiness of some varieties, especially on the young leaves, as in 'Chalk,' 'Catillac,' 'Comte de Paris,' 'Geisen Wildemann.' This is probably a genetic character of some importance. In a few cases the hairs remain on the adult leaves, an exception in the Pear family. The significance of this character I have not yet worked out, but it is an admirable separating character.

Autumn Colour.

A very good character is provided by Autumn colour. There are roughly three groups: those which turn a dull yellow, those which turn black or brown and the third class show some tinge of red or brown, often very striking.

The colours of the following are compared with RIDGEWAY'S Colour Chart. The colours from KLINGSEICK'S Colour Chart follow with a capital K. In this chart colours are numbered, not named.

'Conference'—Mikado Orange to Apricot yellow. K. Red 31.
'Durondeau'—Hays maroon fading to ox blood red. K. Red 5.
'Fondante d'Automne'—Victoria Lake. K. Red 34.
'B. Dumont'—Maroon.
'Duchesse de Bordeaux'—K. 27.
'Uvedale's St. Germain'—Apricot yellow. K. 161.
'Josephine de Malines'—Olive ochre. K. 182.
'Bergamotte d'Esperen'—Yellow to Chestnut brown. K. 202.
'Comte de Lamy'—Apricot Orange. K. 162.

Among those which turn brownish-black are 'Idaho,' 'Beurré Rance' and 'Le Lectier,' in the last two the leaves have a curious habit of dying and curling up on the shoot or spur as if burned.

These characters, I think, are very constant, the exceptions I have noted are where varieties are on incompatible sorts of Quince stocks, in which cases premature Autumn colouring and non-typical colours are often present. A normally yellow variety, for instance, will turn dull red. Those varieties with silvery young leaves always turn yellow or black so far as my experience goes. As an example of the utility of this character, 'William's Bon Chrétien' and 'Dr. Jules Guyot' may be instanced. 'Williams' turning a bright red and 'Dr. Jules Guyot' a yellowish-brown without any red.

My classification table for Pears will be designed on the same principle as that for the Apples, but selecting certain characters which are valuable distinguishing marks for this fruit.

Mr. H. SOMERS RIVERS.

CORRECT identification is very necessary before one can discuss nomenclature. I hope Mr. BUNYARD'S system of classification will enable a variety to be recognized without fail, so that synonyms may be relegated with certainty to their proper place. A sound analytical key has hitherto been impossible owing to insufficiency of essential characters being used.

With regard to nomenclature, I do not see how the method already in use can be altered or improved.

The American Pomological Society adopted, on September 10, 1903, at Boston, a "Code of Nomenclature" which seems to emphasize the difficulties attendant on this.

There are a number of rules, with explanatory notes, the first two of which may be cited:

RULE I.—No two varieties of the same kind of fruit shall bear the same name. The name first published for a variety shall be the accepted and recognized name, except in cases where it has been applied in violation of this code.

Note B to this rule says: The paramount right of the originator,

discoverer or introducer of a new variety to name it, within the limitations of this code, is recognized and emphasized.

Note D.—Existing American names of varieties, which conflict with earlier published foreign names of the same or other varieties, but which have become thoroughly established through long usage, shall not be displaced.

RULE II.—The name of a variety shall consist of a single word.

Note B.—In selecting names for varieties the following points should be emphasized: Distinctiveness, simplicity, ease of pronunciation and spelling, indication of origin or parentage.

Note D.—A variety imported from a foreign country should retain its foreign name subject only to such modification as is necessary to conform to this code or to render it intelligible in English.

Note F.—The use of such general terms as seedling, hybrid, pippin, pearmain, beurré, damson, etc., is not admissible.

Note G.—The use of a possessive noun as a name is not admissible.

Rule I no one will quarrel with, except for the sting in its tail.

Note B is reasonable, as is Note D, but Rule II seems to upset them, unless it can be regarded as applying only to varieties raised or sent out subsequently to the publication of the Code.

It is a counsel of perfection difficult of attainment. A long list of names is given in the catalogue of apples which follows, some 350 pages with about 40 names and synonyms on a page, or some 14,000 in all, in which the revised rules are said to have been followed.

The first English variety one notices is 'Adam Pearmain,' synonym 'Adam's Pearmain.' If Rule II and Note F were adhered to, the apple should have been listed as 'Adam,' *tout court*, and incidentally made one more name in the catalogue.

According to HOGG, it would seem that our universal progenitor was not responsible, but a gentleman named ADAMS in 1826 or thereabouts. Note B justifies our continuing to catalogue the apple as 'Adams' Pearmain' in spite of Note F.

Familiarly we may ask for an 'Adams' and the gardener will give us one, but I see no reason for reducing the name of the apple to this in a catalogue or on the label of a dish of the fruit at a show.

For marketing purposes the name of an apple can be, and usually is, shortened without losing its identity.

'Cox's Orange Pippin' is normally shortened to 'Cox' and will not be confused with 'Cox's Pomona,' which one does not usually find on the market. If it were, probably it would be called 'Pomona,' and 'Cox' would lose the credit of it.

'Bramley's Seedling' may be referred to as 'Bramley' but no doubt the shoemaker of Southwell was intensely proud of his child, and the indication of its origin should be retained in catalogues—why blot out its birth certificate?

'Early Rivers Plum,' the seedling tree of which celebrated its hundredth birthday this year by bearing a good crop of excellent fruit, s known in the markets as 'Rivers.'

If, however, one has raised many varieties of fruits, Note B to Rule II must of necessity go by the board. 'Conference Pear' is not always credited to my firm, although it should be 'Conference (Rivers)' in catalogues, etc.

Even if one's name is attached there is no guarantee that it shall be used: 'Laxton's Superb' Apple was christened thus, but is very commonly 'Superb' only.

Note H to Rule II reads: The use of a number, either singly or attached to a word, should be considered only as a temporary expedient while the variety is undergoing preliminary test.

East Malling has done excellent work with regard to fruit-tree stocks in testing their value, and I venture to think that the 'Broad-leaved Paradise,' raised by my Grandfather in the early years of last century, has shown up as well as any in their trials. Why, after all these years, should it lose its well-known and descriptive name and be fobbed off with a sort of telephone number—'Malling I'?

The penalty of raising and naming a number of fruits is that you cannot be certain how time will deal with them; many are called and few are chosen. A name you consider particularly apt may be wasted. The system of trials at Wisley and elsewhere should make this less of a lottery than heretofore. Before trial, however, fruits must be under name. You can only attach your own name, to show their origin, as a possessive noun.

Herbert E. Durham, Sc.D., M.B., F.R.C.S.

Hitherto recognition of varieties has been largely a matter of reference to those of good vision, trained eyes, and good memory. This is partly because no sufficiently detailed descriptions are available, and such as exist are not regularly methodized, hence clues as to what description to use are somewhat elusive.

The differences between varieties are often slight; moreover, there are often differences among the products of a single tree which need correlation.

Salient features give a means of a primary classification; but the question arises as to which of these and of secondary features a selection should be made.

It appeared to me, towards the end of 1918, that the only plan likely to be practical in the resolution of the problem would be a numerical code or index after the fashion of the successful application of such schemes to bacteria, books, pamphlets and what not. Such indexes were elaborated for Apples and Pears to a certain extent, but it was found that existing descriptions in published works were not sufficiently developed to make out a complete key; and the larger work of collecting a set of standardized descriptions, accompanied by tracings showing external and internal features, gave way to other more insistent works, and the scheme was never completed with key and descriptions, and hence never published. Lately, Professor

J. VERCIER of Dijon ('La Determination rapide des Fruits,' 1934.) has elaborated a code on similar lines; the codes and keys are accompanied by descriptions of fruit and tree characters, and illustrated with schematic sections and diagrams.

According to my scheme the preliminary grouping was done by means of initial letters for season and for colour and size: thus a large block **R** signified a large red apple, an ordinary capital R a medium sized and an italic *r* a small red apple, and so on, with Y for yellow, G for green, etc. Season was shown by S for early or first season, SS for mid-season, and SSS for late. Possibly this use of letters may be considered too parochial, since members of other nations might find some difficulty owing to their different initial letters for the colours.

In the scheme, the important features were placed as integers; secondary external features and tertiary internal ones were given successive decimal places.

A useful proposition for any such key is to choose the respective numbers (0–9) in accord with the distinctness or degree of development of the feature; thus when absent 0, when very well marked 9, and intermediately as might be. This is an aid in figuring out from specimens.

Another matter for attention in descriptions and their keys is the recognition of so-called "king" or terminal fruits as contrasted with the "normal" or laterally borne ones. King fruits are often very aberrant from the type in shape and particularly in their usually (but not universally) thick, short stalks: so far as I have observed the same sort of difference is not so apparent amongst Pears, but some further study is required.

Descriptions should be given methodically in order of headings, and so far as possible *tautologically* and so that a given adjective is of equal intent from one description to another. Descriptions should always be accompanied by tracings of sections both longitudinal and transverse.

One feature which hitherto has been passed over in a more or less indecisive or unceremonious way, is the *lenticel of the fruit*, which varies in size and abundance, but is generally important. If mentioned, they figure as "spots" or "points," which terms do not suggest any distinctive organ. In the Gardeners' Chronicle for November 8, 1930, p. 393, will be seen a figure of a young Pear showing the continuity of the lenticels of the stalk and those on the surface of the fruit. The distinctive term *Freckles* was there proposed to indicate them.

Returning to the code, the features dealt with are Season, General, and Uniformity by letters; Shape, Ribbing, Colour, Freckles, Russet by integer figures, and Eye, Eye-basin, Stalk cavity; Internal features, Tube shape and depth, Cell shape, Cell-slitting, Truelle's line (core limit) and Flesh colour.

The stalk itself was omitted as of insufficient importance for the dignity of an extra profusion of figures; it would be found in the description where *nil, contained, slightly projecting* and *long projecting*

will be found to cover its nature better than dimensions in inches or its fractions.

In Pears, the gross external characters and season were summarized by letters; and figures were applied for General colour, Russet, Symmetry, Eye, Eye-basin, Stalk, Stalk-cavity, Character of flesh; Secondary internal features; Axial sac and Cell shape.

VERCIER limits to seven figures which for Apples include Season, Ratio of length to width, Symmetry and Outline, Depth of basin and of cavity, Colour, Stalk and Eye. And for Pears Season, Ratio length to width, Symmetry and Outline, Type and Shape, Colour, Stalk, Flesh.

For their collective endeavour to get an authoritative work on Cider Apples, the Association Française Pomologique have lately codified a series of headings for descriptive purposes. These may be useful for elaborating a final scheme and are as follows :—

Synonyms, Origin, Localization.

Tree Characters.—General shape, Branches (stiffness, direction, etc.), Eyes, Leaves, Blossom, Date of blossom, Date of foliation. Vigour, Hardiness (weather and parasites), Fertility, Growth best on siliceous or on calcareous soils, Mode advisable for propagation (foot or head), Favourable soil.

Fruit Characters.—Volume or size, Shape general, Shape as to symmetry, Colour, Eye, Stalk. Season for harvesting, ditto for maturity, Keeping powers; Flesh, Juice (density and other analytical data): Use.

Advantages and Disadvantages of the variety (cropping, pests, etc.).

A final and most useful descriptive addition is to name varieties with which the one under consideration *may be confused* and to *point out the differences.*

CODE LETTERS AND NUMBERS FOR APPLES.

SEASON: S=Early. SS=Mid-season. SSS=Late.
UNIFORMITY: A=All alike. D=Dual, of two types. M=Multiform.

PRIMARY EXTERNAL FEATURES.

General.

G	Large green	**RR**	Large, distinct red
G	Medium ,,	RR	Medium, ,, ,,
g	Small ,,	*rr*	Small, ,, ,,
Y	Large yellow	**RRR**	Large, fully red
Y	Medium ,,	RRR	Medium, ,, ,,
y	Small ,,	*rrr*	Small, ,, ,,
R	Large, somewhat red	**U**	Large, fully russetted
R	Medium, ,, ,,	U	Medium, ,, ,,
r	Small, ,, ,,	*u*	Small, ,, ,,

I. *Shape.*

1 Flattened or oblate
2 Rounded or spherical
3 Elongate even or elliptical
4 Elongate uneven or polygonal
5 Conical oblate
6 Conical rounded
7 Conical rounded polygonal
8 Conical elongate
9 Conical elongate polygonal

CODE LETTERS AND NUMBERS FOR APPLES.—*continued.*

II. *Ribbing.*

0 Even, no ribbing
1 Only puckered at eye
2 Distinct apical ribbing
3 Extending to sides
4 Very marked ribbing

III. *Colour.*

1 Green
2 Green, streaked or flushed
3 Yellow, pale
4 Yellow, golden or rich
5 Yellow, streaked
6 Yellow, much streaked
7 Yellow, flushed
8 Yellow, much flushed
9 Red uniformly or nearly so

IV. *Freckles.*

0 Not apparent
1 Small, few
2 Small, numerous
3 Medium size, few
4 Medium, numerous
5 Large, few
6 Large, numerous

V. *Russet.*

0 No russet
1 Only in eye basin
2 Only in stalk cavity
3 Only in basin and cavity
4 Slight, patchy
5 Considerable areas
6 Complete

SECONDARY EXTERNAL FEATURES.

VI. *Eye.*

1 Small, closed
2 Medium, ,,
3 Large, ,,
4 Small, half open
5 Medium, ,, ,,
6 Large, half open
7 Small, open
8 Medium, ,,
9 Large, ,,

VII. ***Eye Basin*** (*width : depth*).

0 None
1 Narrow, shallow
2 Narrow, medium
3 Narrow, deep
4 Medium, shallow
5 Medium, medium
6 Medium, deep
7 Wide, shallow
8 Wide, medium
9 Wide, deep

VIII. ***Stalk Cavity*** (*depth: character*).

0 Slight or absent
1 Shallow and shelving
2 Shallow and steep
3 Medium and shelving
4 Medium and steep
5 Deep and shelving
6 Deep and steep

TERTIARY INTERNAL FEATURES.

IX. *Tube.*

1 Short cone
2 Medium cone
3 Deep cone
4 Truncated, sack-like
5 Short funnel
6 Medium funnel
7 Deep funnel

X. ***Cell Shape*** (*in longitudinal section*).

0 Round
1 Elliptical
2 Ovate
3 Obovate
4 Wide, cordate

XI. ***Cells*** (*slitting into axial sac*).

0 Not ruptured or slit
1 Finely slit
2 Widely slit
3 Widely ruptured ("abaxile" of Hogg)

CODE LETTERS AND NUMBERS FOR APPLES.—*continued.*

XII. *Truelle's Line* (*Core-limit line*).

0 Absent
1 Incomplete, partial
2 Complete, thin
3 Complete, strong

XIII. *Flesh.*

1 White
2 Greenish
3 Yellow
4 Reddened

CODE LETTERS AND NUMBERS FOR PEARS.

SEASON : S=Early. SS=Mid-season. SSS=Late season.

Gross External Features.

R Large, round
R Medium, ,,
r Small, ,,

O Large, oblate
O Medium, ,,
o Small, ,,

E Large, elliptical
E Medium, ,,
e Small, ,,

T Large, turbinate
T Medium, ,,
t Small ,,

P Large, piriform
P Medium ,,
p Small, ,,

F Large, fusiform
F Medium, ,,
f Small, ,,

M Meloid

The letters L or S can be added to E, T, P, or F for long and short forms.

I. *General Colour.*

1 Green
2 Yellow
3 Red-flushed
4 Red-streaked
5 Brown
6 Brown, red-flushed

II. *Russet.*

0 Absent or limited to superficial freckles
1 Only about basin
2 Only about cavity
3 Only basin and cavity
4 Slight, patchy
5 Considerable area
6 Complete

III. *Symmetry.*

1 Regular, symmetrical, even outline
2 Regular, symmetrical, angular outline
3 Regular, symmetrical, bossy about eye
4 Oblique, otherwise symmetrical
5 Oblique, even outline
6 Oblique, angular outline
7 Irregular, asymmetrical
8 Irregular, bossy or angular

IV. *Eye* (*size : openness*).

0 Calyx dehisced, " blind "
1 Small, closed
2 Small, half open
3 Small, open
4 Medium, closed
5 Medium, half open
6 Medium, open
7 Large, closed
8 Large, half open
9 Large, open

V. *Eye-Basin* (*Width : character*).

0 None
1 Narrow, shallow
2 Narrow, medium depth
3 Narrow, deep
4 Medium, shallow
5 Medium, medium depth
6 Medium, deep
7 Wide, shallow
8 Wide, medium depth
9 Wide, deep

CODE LETTERS AND NUMBERS FOR PEARS—*continued.*

VI. *Stalk* (*Length : thickness*).

0 Very short or "absent"	5 Medium, medium
1 Short, thin	6 Medium, thick
2 Short, medium	7 Long, thin
3 Short, thick	8 Long, medium
4 Medium, thin	9 Long, thick

VII. *Stalk-Cavity* (*Width : character*).

0 Absent	4 Medium, shelving
1 Annular depression	5 Medium, steep
2 Shallow, shelving	7 Deep, shelving
3 Shallow, steep	8 Deep, steep

VIII. *Flesh.*

1 Hard	4 Buttery
2 Firm	5 Melting
3 Crisp	

IX. *Cells* (*transverse section*).

1 Rounded	3 Elliptical, broad
2 Elliptical, narrow	4 Turbinate

X. *Axial Sac.*

0 Obliterated	6 Medium, entirely slit
1 Narrow	7 Wide
2 Medium	8 Wide, partly slit
5 Medium, partly slit	9 Wide, entirely slit

Mr. BUNYARD suggested that out of a number of specimens for naming, only the more typical should be retained and the others put aside. Thus all "king" apples were discarded; yet it might happen, as in a tree of 'Schoolmaster' in my garden, that none but "king" apples could be produced. The nomenclature was then simplified, as there would be none left to name. The definition of groups by named-type varieties was less commendable than some more general definition of character—varieties known to-day might become lost and unknown in the future, as has happened in the past. A more general definition is desirable, at most with an example.

Our varieties are, so to speak, artificial, and some artificial (rather than truly scientific or botanical) mode becomes permissible. Hence an artificial numerical code and index becomes useful, if not unavoidable, in giving indications as to what particular description to peruse; moreover, it possesses the necessary elasticity whereby slight variations can be put down by means of alternative figures for any given character: thus "king" and other "aberrant" specimens can be coded. Furthermore, indices can be prepared for any given character which the observer wishes to bring into prominence; for instance, an index for shape, or for ribbing, or for eye, and so forth. The problem is how to find the description which fits in with the specimen placed before one, and it appears that the numerical code and index form the most likely and practical way of assisting both neophyte and specialist.

Mr. BUNYARD has made some adverse remarks on the utility of what I ventured to call the "Truelle Line"—when you cut an apple transversely with a sharp thin blade so that the tissues may not be

crushed and fine details bruised away, in certain cases there is a distinct line of limitation where the core area meets the outer pulp. He suggested that whereas this line or its absence may be useful in the case of cider varieties, it is of no use in the case of table fruits. I venture to state, however, that it has just as much value in the one class as in the other. When I first came to know of it from TRUELLE's works on cider varieties, it seemed worth investigating the subject for table sorts, whilst recognizing that it amounted only to a secondary or tertiary importance.

(On reference to my records, I find that some six dozen culinary and dessert sorts were investigated, in several of which specimens were obtained from widely distant sources to see if constancy resulted; moreover, it was found that the character obtained in a given variety before complete maturity of growth, when colour, size, etc.; fail to give much indication.)

The line, when present, varies in its shape and course in different varieties, and this seems constant to each variety; for instance, whilst it very commonly assumes a bracket-like contour in each section, in the case of some apples (for instance, 'Bismarck') it assumes a more nearly circular course: a clean slice through at mid-cell level, and in a few seconds the appearance is seen.

In his paper Mr. BUNYARD only recognizes two types of leaves, those of the shoot and those of the spur, and considers that they are not comparable. A study of perry pear leaves, however, does not entirely confirm this dictum, for it often happens that whilst basal leaves are frequently oval, at a certain height in both shoot and spur one or more acuminate leaves are present (in some cases a single very tapering leaf occurs in each site)—there is, so to speak, a serial resemblance. I have not particularly studied apple leaves; anyhow, they are more difficult than those of pears. There is, however, a third type of leaf—again I have only looked at pear leaves—*viz.* those which I call "bourse" leaves. These are small in size and are carried on the "bourse area" and belong to baby fruit buds. They participate in form to some extent with the more normal leaves and are sometimes useful in being the only leaves presented with a specimen which has been torn off ruthlessly with more than its proper stalk. Another point which is left aside by Mr. BUNYARD in his account of tree characters is the matter of *lenticels on the bark*. Their size, shape and abundance are frequently extremely useful in determining a variety, especially in the dead season.

Dr. T. SWARBRICK: It is somewhat difficult to discuss such a large question at this point. For myself, I would whole-heartedly endorse the system of classification that Mr. BUNYARD asks us to adopt. Those of us who at times have to sort out and name the various fruits, not only apples, but black currants, gooseberries, raspberries and strawberries, that are sent to us, sooner or later have to work out some kind of classification. The one that we have adopted at Long Ashton is definitely a natural rather than an artificial one. We have already published a classification and identification key for red

currants which definitely starts from the natural grouping system. The first difficulty that confronts us is that of being sure that we have typical specimens sent to us. In this connexion we should insist upon having leaves as well as fruits, and in the tree fruit some description of the habit of the tree. The development of Mr. BUNYARD's system will definitely give us a means of putting into the hands of anyone who is intelligent enough to understand our rather technical language, something in print that they may use for themselves. I hope that it will sooner or later result in many fewer specimens being sent to the various places for identification. There is, however, a serious difficulty which confronts those of us who have any experience with apples—namely, that the fruits do not always come true to type from different localities. A large number of factors—for example, age of tree, rootstock, soil, climate, pruning, etc.—may and often do alter the general appearance of the apples. Quite often the wide experience we have had enables us to give a name to an off-type apple. It is quite impossible under these circumstances to explain to the person who produces it the reason for giving it that particular name. There are extraordinary examples of this kind of thing in the Show at the present moment. Those of you who are familiar with the Society's trials at Wisley will know that they have sent up quite a number of specimens to the Show along with the 800 odd varieties. The variety 'Lord Derby' may be cited. You will find that this apple sent from Wisley is not typical of the variety, since the characteristic ribbing is practically absent—the apples are almost smooth. A careful observer has only to walk round the trials being carried out at the R.H.S. Gardens to realize that this is a common feature. Varieties which one normally expects to be ribbed are largely devoid of this particular character. Apparently the particular conditions of the R.H.S. Gardens are such that this particular feature tends to be obscured.

There is very little more that I can usefully say at this point. I hope that other people will also give their views, since we are very much in need of a key and a system for the classification of apples, plums and pears. We need to have in print something by which we can run down the varieties in the way that we can run down the flowers of the country-side. We are not necessarily agreed at the moment upon the best system to adopt or the kind of words we should use to describe the features we use for identification of, for example, the serrations of the leaf edge. This, I think, could very soon be settled if those of us who are interested could get ourselves together into a body for this purpose. If this could be done we could then make some official pronouncement which would be likely to carry authority. We must not necessarily borrow or use all the words used by LINNAEUS and HOOKER, or the other systematic botanists, but we can take and use those words and terms whenever it suits our particular purpose.

H. V. TAYLOR, Esq., B.Sc., O.B.E.: Fortunately I have not to read a paper, but to enter into a discussion on the papers which have

been read. I would like to remind our Chairman that about fifteen or sixteen years ago he was taking the Chair at a meeting where the paper was not on the subject of the nomenclature, classification and identification of apples, but on the nomenclature, classification and identification of potatos. At that time people adopted exactly the same method for naming potatos as they are doing for apples. They used to send in tubers nicely wrapped up, sometimes in pieces of tissue paper, and they wanted to know the names. Some people said they could tell them and some people said they could not. It was all very mysterious. At any rate a name was generally produced and sent back; sometimes it was right, sometimes it was wrong.

But your Chairman and myself rather came to the conclusion that the safest way of all was not to try and identify the variety from the tuber only, but to have the plant grown. It did not take very long to grow a potato, but it is a little different with apples. When we began to grow these different kinds we found that though we had a very large number of names we had very few varieties. We got rid of something like 118 names and substituted the right name for the 'Up-to-Date.' By growing the plants and recording all the characters on paper—the hang of the leaf, the colour of the flower, and similar characters—it has been possible to arrive at one name for most varieties, and that problem for potatos is solved.

Now let us have a look at the apple. I have not the slightest doubt, if we can study all the characters just as Mr. BUNYARD has done, that we could get a system which would safeguard the nomenclature. But in identifying apples the trouble is that you have not got all the characters, and you cannot really wait to grow the tree to prove what it is.

You may ask why people send apples for identification. All I can say from my experience is that when a person moves into a new house he is inquisitive to know the trees by name. They used to send a lot of apples to the Ministry of Agriculture, and when I took charge we were in the habit of supplying names which were sent back to the people. I rather wondered if we were right to continue this, so I got hold of all the systems of classification that I could find, and in particular that of Mr. HOGG. I well remember having an apple sent to me which was absolutely green, with not the least trace of colour of any kind whatever, and the sender said this was a late dessert apple, nice to eat about the month of March. He wanted to know the name. So I got down the book and gradually traced it down to where it said 'Cox's Orange Pippin.' I thought to myself, this must be all wrong; but when I tasted it, I found it was a 'Cox's Orange Pippin.' It was a bud sport that this man had struck that gave him a green 'Cox.' The system in that case worked smoothly and well. So I thought, this is a fine system of classification, I will try it on the next one. The next was a very tiny round red apple. I traced this out to be 'Tyler's Kernel,' which is a huge and exceedingly long apple. The system here worked wrongly. That system works sometimes and not at

others, the reason for which Mr. BUNYARD assures you is that all these characters are not sufficiently definite.

Then I turned to Mr. BUNYARD'S system. You know it quite well. Apples are divided into a certain number of groups, a green group, a green group with red stripes, etc. I could never make up my mind into which group the apple should be put.

Let me take 'Lane's Prince Albert.' Quite naturally if you have a typical 'Lane's Prince Albert' there is no difficulty about the group, for it should go into the green group with red stripes; if you start off in that group you will probably get right. But you can get apples off a 'Lane's' tree that have no colour at all. If these were sent to you, you would start the identification in the green group. Further, Mr. BUNYARD'S groups divide apples into flat apples, round apples, conical apples, oval apples, and oblong apples. Provided they are practically flat, like 'Beauty of Bath,' it is simple. You merely say "flat" and you are on the right scent. If they are perfectly oblong, there is no difficulty; or if they are typically conical, like 'Worcester Pearmain.' But there are plenty of apples that are intermediate, and I find always a difficulty in making up my mind whether the apple is really flat or round or conical. Take even 'Beauty of Bath': there are specimens that are typically flat, but you sometimes get examples that are almost round.

At one time I found the most reliable character was the season of maturity. If you picked up an apple and thought, "ripe in October," you ran your finger along the lines in Mr. BUNYARD'S classification for October. Then cold storage was invented, and this method was no longer useful. Apples were sent for identification in February that under normal storage would have been ripe in October.

All these difficulties made me realize that the correct name might only be arrived at three or four times out of ten, and I became dissatisfied.

I am firmly convinced that we have to deal with the apple as with the potato. We have potato testing grounds where all the varieties of potatos are grown and each character recorded—the growth of the plant, the kind of flowers it has, whether it has pollen, and so on—every single character which may be of importance later on in pinning down the particular name to that particular plant. The character of the tubers, of course, is needed, but that is only one character. I think we have to do the same thing with the apple, and I am very glad to say the R.H.S. made a start over ten years ago. There is a fruit-testing station; all the varieties of fruits now being bred and the old ones are being planted at Wisley. Recorders there take accounts of every one of the characters. When all these characters are recorded on paper, I think it may be possible for us to begin to put them into a proper system of classification, and then later on we may be able to devise some method by which we can take an unknown apple and give it the proper name.

I agree with Mr. BUNYARD, that the only thing we can do at the

moment in the absence of this knowledge of details is exactly what he has suggested. I find myself doing this: when I have an apple before me, I begin to think of apples which it resembles, and I form an hypothesis mentally, as he has done for you diagrammatically. A small, red, flat apple makes me think of the groups of that type: 'Devonshire Quarrenden,' 'Winter Quarrenden,' 'Duchess's Favourite,' and so on. Having thus limited it down, it is sometimes possible to consider the varieties of the group and nearly identify it. One might take up an apple and say that it is something like a 'Blenheim.' If we only had a group for the 'Blenheim' type, just as Mr. BUNYARD has given for the 'Cox,' we could go into the details, and probably get the right name, but unfortunately it is not so easy as that.

Let us just look at Mr. BUNYARD's group of the 'Cox's.' I was hoping that he had gone on what he called the "telephonic address" rather than the telegraphic, because, whilst he has given you the characteristics of the 'Cox's,' and the others, you must remember that these factors alone are not constant. He gave you the 'Cox' in which the "eye" was closed and the 'Ross's Nonpareil' in which it was open. But you will find some 'Cox's' where the segments have shrivelled up and the eye is open. Then as for the colour of the buds; this can only be done by comparison, for some are deep pink, some are pale pink, and you might pick up one odd flower and have some hesitation in saying whether it is deep or pale pink; but I agree that if you have samples of other varieties in front of you, then by comparison you can say one is a deeper or paler colour than the other. But for the purpose of identification you would want a full range for comparison.

I also agree that Mr. BUNYARD is quite right about the question of the tube. I, too, have cut many apples and looked at these tubes. As he says, some are deep, some are shallow and some are medium; but what is really meant? By sticking to the telephone system, one could say that if they are more than so many millimetres they are deep, and if they are under so many millimetres they are shallow, and this would be something definite. The words "shallow" and "medium" have no concrete meaning.

Whilst I have come to this conclusion, I would like to thank Mr. BUNYARD most heartily and generously for the wonderful work he has done and for the unselfish way in which he has taken this work up. Here is a business man, the head of huge nurseries, and he spares the time to study pomology scientifically. Now he generously comes forward and gives the whole of the information to the public.

We want to go on with the fruit-testing scheme at Wisley and get the facts recorded about all the varieties. The time will come when all the facts are available, and building into a system of classification can be done which will make identification very accurate. It seems to me at the present time all that one can do is to take the apples to a man who is always amongst apples and say, "Have you ever seen this apple before?" Sometimes he will recognize the variety and give you a name. But the varieties any one man can remember is limited,

so he would probably be right only about fifty times out of the hundred.

R. T. PEARL, Esq., M.A.: I cannot let this occasion pass without paying my tribute to the prominence of Mr. BUNYARD in this particular field. No individual in this country has played so large a part in the modern literature of systematic pomology. There is hardly any aspect of the field in which he has not at some time given some guidance. I hope that one day we shall be able to look to him to replace HOGG's Fruit Manual with a work conceived on the spacious lines of the works of ALPHONSE MAS. I look on this paper as an appetizer for the banquet which must certainly follow.

There are a number of points in Mr. BUNYARD's paper which interest me specially and to which I will briefly refer. First of all, my name has been mentioned in connexion with stylar characters of apple flowers. I think there is little doubt that my own comments (*Jour. Pomol. Hortic. Sci.*, X (1932), p. 23) on Mr. BUNYARD's earlier paper, the one published in 1912, tended to over-emphasize the variability of these characters, just as I think that Mr. BUNYARD seemed then to underestimate that difficulty. But I had no intention of suggesting that stylar characters are of less value in classification than other important characters of the flower. On the contrary, I agree that in the hands of an expert it is a valuable character in diagnosis. I would say that Mr. BUNYARD's statement of the case in the present paper could hardly be bettered.

To turn to more general matters, I am glad Mr. BUNYARD has emphasized the necessity for taking flower and vegetative characters into account in naming varieties. It seems to me that naming from the fruit alone combines for the namer all the uncertainties of the average punter at a race meeting with the studied shufflings of a Cabinet Minister during question time. I agree that floral characters are very constant and are capable of giving much more assistance both in naming and in classifying varieties than has been generally recognized. I hope that in his provisional scheme for grouping varieties he will include rather more characters of the flower, such, for instance, as the pose of the corolla and possibly of the stamens, both of which are easily appreciated on a first inspection. I think, too, some mention of tree habit and winter bud colour is worthy of a place. The more guiding lines we have the better. Personally I have also found the form of the cluster base useful in identification, but I would not suggest that it could or should form one of the main lines of classification.

I am very doubtful of the value of numerical descriptions of petals and core dimensions in the preliminary sorting out of varieties, although it is of the utmost value in fuller descriptions of varieties. In practice I think that it would mean that, for naming an apple variety, instead of demanding a modest six specimens of fruit we should have to ask an enquirer for a full 40-lb. box, collected as a properly randomized sample at that.

In regard to pears there are one or two additional characters which

may be of use—and I should rather like Mr. BUNYARD's views on these points—particularly the colour of the young leaf stalk on the foliage spurs, which varies very much from various greens to a brilliant red; also the colour at the base of the new growth on the flowering spurs. In the pear the colour and size of the anthers seem to be points of diagnostic value much more than in apples. I have not had a great deal of experience of the description of pear varieties, so that I mention this tentatively. I am still uncertain whether some of these characters are not very much influenced by environmental conditions, and possibly by root stock.

Lastly, regarding the principles of classification, in pear and apple varieties we are not as a rule dealing with plants from a broad species concept, but we are considering the differences between a large number of often closely related vegetative clones. Here I think we need very definitely the assistance of the geneticist in assessing the value of characters as indicative of relationship. One would like to see a comprehensive account of the mode of inheritance of the more important morphological characters of flower and fruit. Until we get that we are working in the dark as to the natural affinities of many of our varieties. One realizes, of course, that the fundamental difficulties are very great—indeed the accredited complex constitution of the nucleus in Pyrus may well make the practical solution of the problem insuperable from the genetical standpoint. Nevertheless I am impressed with the remarkable resemblances in some characters, for instance, of the flower and fruit of varieties in Mr. BUNYARD's Cox family—such varieties as 'Cox's Orange,' 'Sir John Thornycroft,' 'Ellison's Orange,' 'Laxton's Superb,' and I would add 'Allington Pippin' also. In some of these cases one knows there is "blood relationship" and one would like to have more definite scientific evidence as to the way in which these characters—or some of them—may be inherited. I hope we may look for some help on this point from Long Ashton, the John Innes and other research stations, which are engaged on genetical investigations with fruit plants.

THE CHAIRMAN: If no other speaker wishes to speak, I am sure I am expressing your wishes when I thank Mr. BUNYARD, Mr. RIVERS, and all the other speakers for their valuable contributions to this subject. They have all made very valuable contributions.

I was particularly interested to hear the proposal that experts should get together—it is always rather dangerous when experts get together, but in this case the danger may be overcome—and start to work out a thorough basis for classification. Mr. BUNYARD has shown the way, but it is quite evident that much more than can be done by a single individual is required if the groundwork for a proper classification is to be laid.

Dr. DURHAM has referred, and other speakers have referred, to this and that character. When you come to think of it, a person who sends you an apple and asks you to name it might just as well send you some ancient old man with a bloated face, a protruding stomach, a bleared

eye and a bald head, and ask you to tell him the name of the man's family. An apple in its mature state is of that order of things. Therefore, classification, if there ever is to be a scientific basis for it, must start with an examination of the flowers, the young leaves and the buds, the soils and all the rest of the conditions. There is at Wisley invaluable material on which that purely routine morphological work might be done. I venture to think until that is done we can still go on holding these Conferences and still be making progress, but still fall short of any really businesslike achievement. I hope the practical outcome of this Conference will be that there will be a thoroughgoing investigation of all the different varieties which are growing at Wisley and elsewhere ; a diagnosis of all their characters of leaf and flower and bud, and when these are set forth the experts will meet. They will then find it fairly easy to complete the admirable work which Mr. BUNYARD has begun and give us schedules, either of the comparative kind imagined by Dr. DURHAM with numbers, or the brighter looking things with letters, by which we can name an apple with as much certainty as the expert can now name it.

When this is done, of course, the last Conference on the classification of the apple at all events will have been held. This has been such an interesting one that we shall be very sorry for our successors not to have it repeated. We thank very warmly those who have made such valuable contributions to this Conference.

THE ORIGIN OF CULTIVATED FRUITS AND THE RAISING OF NEW VARIETIES.

By M. B. Crane

(John Innes Horticultural Institution, Merton).

The experimental breeding of our edible fruits began over a hundred years ago with the work of Thomas Andrew Knight. Of the fruits he raised, the Cherries 'Waterloo,' 'Elton,' 'Black Eagle' and 'Knight's Early Black' are still widely grown; indeed many consider that the quality of the variety 'Waterloo' remains unsurpassed. It is not only, however, to Knight's personal achievements that past and present generations of fruit-growers are indebted: the lead he gave in the sexual reproduction and cross-breeding of our fruits has proved of inestimable value. I need hardly recall that Knight was for many years a distinguished President of this Society, and the results of many of his investigations are described in the Transactions of the Society published in the early years of the nineteenth century.

Since Knight's time, breeding experiments with our domestic fruits have been very considerable, and in this country the achievements of the Rivers of Sawbridgeworth, and Laxtons of Bedford, from deliberate cross-breeding have been outstanding. In general, however, breeding experiments with fruits have been conducted in the search for new forms possessing desirable characters rather than for the purpose of studying the mode of inheritance of their numerous characters. Consequently, although in a general way much knowledge is available, often it is not sufficiently detailed or precise to be of use for the purpose of genetical analysis or to be of real guidance in further breeding experiments. Our tree fruits, especially Apples and Pears, do not provide favourable material for the study of heredity. The length of time which elapses from seed to maturity, the space the seedlings occupy, the cost of maintenance, etc., all militate against large-scale investigations unless exceptional facilities are available, while at the same time their involved polyploidy and complex heterozygous constitution makes large families especially desirable. Indeed, for the purpose of genetical analysis and for any practical breeding experiment where the aim is to obtain new varieties which combine the maximum of desirable characters, large families are essential.

Our fruit trees, like all plants and animals, owe their identity to certain materials received from their parents. These materials are present in every cell which goes to make up the plant, but their transmission from one generation to another depends upon the production of specialized cells, in plants the pollen and egg-cells—the male and female germ-cells respectively. These reduced germ-cells contain one only of each pair of chromosomes contained in the other cells of the

plant, and it is by the union of these specialized cells, one from each parent, in the act of fertilization that the genes, the units of inheritance which determine the characters of the plant, such as habit and vigour of growth, size, shape and colour of fruit, etc., are transmitted to their offspring. It is therefore evident that the constitution of a plant and the way it has originated will be reflected in the variation and in the mode of inheritance of its characters. Consequently, before attempting an account of the raising of new varieties, a brief description of the nuclear constitution of our cultivated fruits and the various ways in which they have originated may be of interest.

From an evolutionary point of view we can tentatively arrange our races of cultivated fruits in five classes, according to the way in which they have originated, although in some cases the process or method of origin may merge from one class into another.

(1) In the first class we have examples of gene mutations and selection within a diploid species giving rise to numerous varieties. In this way in *Prunus persica* there have arisen varieties with hairy (Peach) and smooth (Nectarine) fruits, white or yellow flesh, clinging or free stones, eglandular or with reniform or globose foliar glands, small or medium or large flowers, green or lightly pigmented or deeply pigmented leaves, etc. Similarly, in Raspberries we have yellow or red fruits, deep red or pale red or green spines, hairy or sub-glabrous growth, flat or curled, pointed or obtuse leaves, etc.

(2) The second process has been by the interspecific hybridization of diploid species not accompanied by chromosome duplication or other cytological aberration. For example, three species of Ribes appear to have entered into the constitution of the garden Red Currant. They are *Ribes vulgare, R. rubrum* and *R. petraeum*. Some cultivated varieties are predominantly *vulgare*, others *rubrum*, and others *petraeum*. Some combine the characters of *rubrum* and *vulgare*, and the characters of others suggest that they have been derived from *petraeum* crossed by *vulgare*. The species and all the varieties examined have been found to have sixteen chromosomes, two sets of eight.

(3) The third way in which cultivated forms have arisen appears to have been by simple auto-polyploidy, *i.e.* the duplication of the chromosomes without hybridization being involved—for example, by the functioning of unreduced germ-cells or by somatic duplication. There are, for example, tetraploid forms of Raspberries with four sets of seven chromosomes which from their general characteristics appear to be auto-tetraploids. They include such varieties as 'Belle de Fontenay,' 'Merveille Rouge,' 'Hailsham,' and 'Everbearing.'

(4) The fourth process has been by interspecific hybridization of polyploid forms. From the history, genetics and cytology of the genus Fragaria there is but little doubt that the garden Strawberry arose from hybridization between the octoploid species *Fragaria virginiana* and *F. chiloensis*.

(5) The fifth way in which cultivated forms have arisen has been by interspecific hybridization accompanied by the functioning of

unreduced germ-cells or by chromosome duplication, and this seems to have played a large and important part in the origin of our cultivated fruits. The domestic Plums, *Prunus domestica*, Apples and Pears, and the 'Duke' race of Cherries appear to have arisen in this way. Examples which have occurred in our own time are the Loganberry, the Veitchberry, the Laxtonberry, and the Blackberries 'Bedford Giant' and 'John Innes.' Full details would go beyond the scope of this paper, but the Veitchberry, a tetraploid with twenty-eight chromosomes, arose from crossing a Raspberry and a Blackberry with fourteen chromosomes. The Laxtonberry, a heptaploid with forty-nine chromosomes, arose from 'Superlative' Raspberry with fourteen and the Loganberry with forty-two, thereby combining the full (unreduced) complement of the Loganberry, forty-two, with seven, the reduced complement of the Raspberry. The Blackberry 'John Innes' arose in a similar way, and Mr. LAXTON has kindly informed me that 'Bedford Giant' appeared in a selfed family of Veitchberry seedlings. The Veitchberry is a tetraploid with twenty-eight chromosomes, and 'Bedford Giant' is a hexaploid with forty-two, and here again an abnormal unreduced germ-cell with twenty-eight chromosomes appears to have combined with a normal reduced germ-cell with fourteen chromosomes. In the same way the 'Duke' Cherries appear to have arisen by the intercrossing of the diploid species *Prunus Avium* with the tetraploid species *P. Cerasus*.

The origin of our domestic Plums is more speculative, but the results of our investigations at Merton lead us to the conclusion that the diploid species *Prunus cerasifera* and the tetraploid species *P. spinosa* are involved in the origin of our domestic Plums. A cross of diploid by tetraploid accompanied by chromosome duplication would give a hexaploid such as *P. domestica*. Such a view is further supported by a consideration of the variation which occurs within these species. For example, in *P. cerasifera* the ground colour of the fruits is yellow and the anthocyanin red. In *P. spinosa* the ground colour is green and the anthocyanin blue; and the range of variation in both species is limited. In *P. domestica*, however, we have both red and blue colours and also yellow and green grounds, and from various recombinations an infinitely wider range of variation results.*

There is general agreement with the view that a number of species of Pyrus are involved in the origin of our cultivated Apples. It is only recently that Pyrus species have been the subject of cytological and genetical study, but such investigations have shown that they have an exceptionally complex chromosome constitution. Cultivated

* Since writing this paper I have received a letter from Dr. V. RYBIN, Detskoe Selo, Leningrad, U.S.S.R., which strongly supports the above view regarding the origin of the garden Plum *Prunus domestica*. Dr. RYBIN informs me that he has raised seedlings from crosses between *P. spinosa* L. and *P. divaricata* Led. = *P. cerasifera* Ehrh. One of these seedlings is of exceptional interest: it is a hexaploid, and larger and more robust than the normal triploids of the same origin. Dr. RYBIN also states that in the forests of Maikop district, North Caucasus, *P. spinosa* and *P. divaricata* hybridize rather freely, and the characters of the branches, leaves, flowers, fruits, stones, the colour of the bark and other characters of the hybrid trees show clearly their close relationship to the parental species.

varieties both of Apples and Pears are of two kinds, those with thirty-four and those with fifty-one chromosomes. Their reduced or haploid number is therefore seventeen, but it has been concluded that the basic number is seven and that the seventeen chromosomes of the genus Pyrus are made up of three chromosomes repeated three times and four chromosomes repeated twice. In other words, the varieties of Apples and Pears with thirty-four chromosomes are partly hexaploid and partly tetraploid. There is but little doubt that the varieties with fifty-one chromosomes, such as the Apples 'Bramley's Seedling,' 'Blenheim Orange,' 'Baldwin,' 'Ribston Pippin,' 'Gravenstein,' 'Warner's King,' 'Gennet-Moyle,' 'Washington,' 'Belle de Boskoop' and 'Reinette du Canada,' etc., arose by the functioning of an unreduced germ-cell, whereby thirty-four chromosomes combined with seventeen, giving rise to forms with fifty-one chromosomes. The same is true of such varieties of Pears as 'Pitmaston Duchess,' 'Catillac,' 'Uvedale's St. Germain,' 'Beurre d'Amanlis,' 'Beurre Diel,' 'Conseiller de la Cour' and 'Vicar of Winkfield.'

The consequences of the different methods of origin and chromosome constitution of our cultivated fruits are seen in various ways. Self- and cross-incompatibility, both in inheritance and in its varietal behaviour, is, for example, a comparatively simple phenomenon in the diploid Cherries; in the hexaploid Plums it is more complex, and in Apples and Pears it is even more complex than in Plums. There is, that is to say, a direct correlation between the behaviour and frequency of incompatibility and the chromosome number and complexity.

A comparison of the early seedling growth of diploids and polyploids is also of interest. In seedlings of the diploid sweet Cherry there is no period of juvenile growth comparable to that found in the polyploid Plums, Apples and Pears. The leaves of seedling Cherries are of course smaller during the early weeks of growth, but after a few months their leaves are practically as large as those of established varieties twenty or more years old. In Plums, Apples and Pears, however, there is a prolonged juvenile period of growth, which seedlings have to grow out of before flowers and fruits are formed. In my experience seedling Cherries come into bearing at an earlier age than Plums, and Plums generally grow out of the juvenile condition quicker than Apples and Pears.

Again, when we compare the studies of the systematic pomologist, the cytologist and the geneticist, a striking parallelism is frequently evident in their results and conclusions. Thus the systematist long ago found that he could satisfactorily classify Peaches and Nectarines according to whether they had smooth or hairy fruits, small, medium or large flowers, and so on. The geneticist found that the mode of inheritance of these characters conformed to the comparatively simple Mendelian rules; and the cytologist found *Prunus persica* to be a simple diploid plant with two sets of eight chromosomes. At the other extreme, attempts to provide a really satisfactory classification of Apples have been numerous, and systematists continue to find such a

classification an involved and difficult task. The geneticist and practical breeder is likewise beset with many problems and finds our cultivated Apples extremely difficult to analyse; and finally the cytologist has found them to be secondary polyploids with a highly complex nuclear constitution. Since the complexity of the nucleus and the manner of chromosome pairing is reflected in the range and nature of the variation and in the mode of inheritance of characters, it is only natural that some correlation should be evident in the results of systematic, genetical and cytological studies, and it is probable that any advance by one set of investigators will prove of importance to the others. Indeed, the recent classification of Apples and Pears into two groups, those with thirty-four and those with fifty-one chromosomes, is of practical value to the fruit-grower and the breeder; it may also be of use to the systematic pomologist.

The Breeding of Cultivated Fruits.

To attempt a detailed account of the genetics of fruit trees would exceed the limits of this article, and since in conjunction with my colleague, Mr. W. J. C. Lawrence, I have described elsewhere the results of breeding investigations with various fruits,* I will only attempt to describe certain aspects which may directly affect the practical breeder, and which may prove of some guidance in the choice of parents.

First of all, the breeder can usefully divide our cultivated fruits into two classes: (1) the diploid forms and (2) the polyploids. The variation and mode of inheritance of characters are generally found to be less complex in the diploid than in the tetraploid forms. For example, in *Prunus persica*, a diploid species with two sets of eight chromosomes, we are familiar with hairy fruits (Peaches) and glabrous fruits (Nectarines). There are no intermediate forms, variation is sharply discontinuous, and the hairy character of the Peach behaves as a simple dominant, the glabrous Nectarine being recessive. Nectarines will always breed true to the glabrous condition, but Peaches either breed true or give approximately three Peaches to one Nectarine, according to whether they are homozygous or heterozygous. Peaches and Nectarines can also be classified according to whether they are eglandular, or have reniform or globose foliar glands. The eglandular and reniform gland types are homozygous, and both forms breed true when selfed. Varieties with globose glands are always heterozygous and give eglandular, globose and reniform glands in the proportions of 1 : 2 : 1. Many other characters in the Peach behave in a similar way; the characters are governed by a single pair of genes, and to combine any of them by cross-breeding is a comparatively straightforward task. In other diploid fruits, such as the Myrobalan Plums, the diploid Raspberries and the diploid wild Strawberry *Fragaria vesca*, many of the characters investigated have been found to follow com-

* Journal of Pomology, vols. 2, 7; Journal of Genetics, vols. 22, 24, 28; Genetica, vol. 9.

paratively simple rules. Among the polyploid fruits, however, such as our hexaploid European Plums, which have six sets of eight chromosomes, the Garden Strawberry, with eight sets of chromosomes, and the involved polyploid Apples and Pears, variation is less discontinuous and the mode of inheritance of the characters is more complex. A given character may be governed by a number of genes, instead of by a single pair as in diploid forms, and as a result it is common to find a wide range of variation in their characters and numerous intergrading forms.

The possibilities of obtaining fertile progeny from cross-breeding in polyploid forms are often limited by the numerical relations of their chromosome complements. For example, with very rare exceptions, the offspring from a diploid crossed tetraploid will be triploid, and those from a tetraploid crossed hexaploid will be pentaploid. Since fertility depends upon an orderly process of reduction leading to the formation of germ-cells with half the number of chromosomes of the body cells, such forms as triploids with three sets of chromosomes and pentaploids with five sets are invariably highly sterile and usually unproductive. Apart from other considerations it is obvious that an odd number cannot divide evenly, and consequently at germ-cell formation irregularities occur and sterility inevitably follows.

For this reason the so-called 'triploid' varieties of Apples and Pears with fifty-one chromosomes are likely to prove of but little value as parents. Among our cultivated fruits forms with an odd number of chromosomes are exceptional, and in most fruits they are highly sterile and unproductive. Actually, the triploid Apples and Pears are characterized by a high degree of sterility, but the condition of our pomiferous fruits is in many ways exceptional: seed fertility is not so closely related to fruit production, and consequently this allows varieties with an odd-multiple chromosome complement and a high degree of sterility to be of economic importance. Nevertheless, although the triploid Apples and Pears are themselves of vigorous growth and include some of the most valuable varieties, they are best avoided by the plant breeder, for though an occasional exceptional seedling may occur, the offspring from triploids crossed triploids, triploids crossed diploids, and diploids crossed triploids have an irregular and unbalanced chromosome constitution, and as a result many of the seedlings die at an early stage, and the large majority of those which survive are weak and of no commercial value.

Among our cultivated fruits asexual reproduction is the rule, and this allows forms to be perpetuated no matter what their genetic constitution may be. The triploid Apples and Pears, for example, since they cannot even approximate themselves by sexual means, owe their continued existence to continued vegetative propagation. Most of our varieties of fruits are heterozygous, and consequently almost any family raised from crossing varieties will give a wide range of variation, from which selections may be made. In Plums, seedlings from crosses between such rich-flavoured Plums as 'Cambridge Gage,' 'McLaughlin's

Gage,' 'Jefferson,' and 'Transparent Gage' invariably give a high proportion of seedlings with a rich flavour, whereas crosses between Plums with a relatively poor flavour, such as 'Pershore' and 'Pond's Seedling,' give a high proportion of poor-flavoured seedlings. The practical conclusions are therefore self-evident: to obtain good flavour the breeder should select good-flavoured varieties as parents, and from them relatively small families may provide new varieties of good flavour. When, however, the breeder desires the combination of other characteristics with flavour, as, for example, the resistance to silver-leaf disease evident in the variety 'Pershore,' with the colour and flavour of 'Victoria,' or, again, the size of 'Pond's Seedling' with the self-fertility and flavour of 'Denniston's Superb,' much larger families are necessary and probably further generations will have to be raised before the desired combination is obtained.

Similarly in Apples and Pears, crosses between varieties of good shape, colour and flavour are likely to give a proportion of good seedlings in the immediate generation. Experience has shown that crosses between dessert and culinary varieties are unlikely to give desirable seedlings: at the best such crosses generally result in a dual purpose Apple over-large for dessert, and lacking the full dessert quality and the best properties of the culinary variety. It is best to specialize and cross on the one hand only between dessert, and on the other between culinary varieties.

In the Apple, variation with respect to colour, size, shape and flavour and other characters is remarkably wide. The inheritance of characters is also complex, and it is possible that we may have as many as six genes governing any one or other character of a variety. For example, we may have six genes determining the red colour of the fruit, giving different intensities or grades of red. We may also have a similar number of genes governing the ground colour, giving different intensities of green or yellow, and from the many possible combinations many different forms occur. Some combinations may be closely alike and indistinguishable to the eye, but among varieties of Apples many different combinations are observable.

Experimenters engaged in the practical breeding of fruits have sometimes doubted the Mendelian theory of heredity. The simple laws of inheritance they have been led to expect did not seem to apply to such fruits as Plums, Pears and Apples. The phenomenon of dominant and recessive characters was obscure, and simple discontinuous segregation was not always evident. However, it may be pointed out that in polyploids, when a number of cumulative and differential genes govern the same character, the expression of dominance is essentially more variable. Indeed, certain balances may suggest that a character is recessive, whereas others may point to dominance, and it is noteworthy that although frequently expressed in degree, complete dominance of characters is rarely met with in breeding investigations with Apples. For example, the experimental evidence indicates that small size and red colour of the fruits are dominant characters in

Apples, but in any large family raised from crossing diverse varieties, an almost continuous gradation occurs from one extreme to the other. In the European varieties of Pears the green skin of the fruit appears to be dominant to the russet brown skin. On the other hand, in the Japanese Pear, *Pyrus serotina*, the russet character of the skin is dominant to green skin, though various intermediate forms occur between the full russet and pure green forms.

That much has been achieved by the plant breeder is evident from the numerous excellent varieties of fruits raised and introduced into cultivation during the past and present century. Nevertheless even our most esteemed varieties often show some serious defect. Varietal differences in respect of susceptibility and resistance to various pests and diseases are commonly seen, and though preventive measures such as spraying, dusting, etc., can be highly effective, their cost is very considerable. The solution of these and other important pomological problems undoubtedly lies in the raising of ideal types in which the maximum of desirable characters are combined, and the odds are greatly against this being accomplished except by carefully planned and large-scale breeding investigations.

ORCHARD FACTORS AFFECTING FRUIT QUALITY.

Chairman: Sir JOHN RUSSELL, F.R.S., Director Rothamsted Experimental Station.

THE CHAIRMAN: We are to have the pleasure of listening to a talk this afternoon from Dr. Wallace. Dr. Wallace is known to all of you by the admirable work he has been carrying out for some years past at Long Ashton, one of the great research stations in this country, indeed, one might add in the Empire, for the stations at Long Ashton and East Malling are known wherever fruit is grown because of the quality of their work.

Dr. Wallace's special line has been the nutrition of fruit trees, but being no rigid specialist he has brought within his ambit all the external conditions that affect the growth of the tree and the yield and quality of the fruit. These investigations have been of great importance for fruit growers and indeed to all who are concerned in the growth of trees. I recently had occasion to discuss forestry problems with a group of foresters, and they admitted that they themselves knew very little about the feeding of forest trees; such little information as they had was largely based on the work of Dr. Wallace on the nutrition of fruit trees.

DR. T. WALLACE

IT is the common experience of all growers of fruit that the quality of their produce can be greatly affected by changing orchard conditions. It is also realized that the task of determining the effects of various orchard factors on fruit quality in any particular case is a very difficult one, and indeed in many instances it requires a life-long experience before quality can be controlled to the extent to which the grower desires. Many of the reasons for the difficulties encountered are obvious to the fruit-grower, but the great complexity of the problem only becomes apparent when the subject is investigated in a systematic way.

For the past eight seasons comprehensive investigations relating to the subject discussed in this paper have been in progress at Long Ashton, the fruit most usually studied being the Apple and particular attention being given to the special storage qualities and chemical characters resulting from various orchard factors.

The large body of data which has been collected in these experiments has not yet been fully analysed, but, nevertheless, at the present stage, it is possible to draw many important conclusions regarding the effects of orchard conditions on fruit quality and to illustrate many points in connexion with the subject which are of great practical importance to the fruit-grower.

Since the storage and chemical aspects of the problem have received special attention, it will be convenient to illustrate many points in

the present paper by data relating to these. The Apple is used to illustrate most of the points made.

The orchard factors which may affect fruit quality may be grouped as follows :

(*a*) *Materials*—including classes of fruit, varieties, rootstocks in the case of most tree fruits, and the age of the tree.

These factors are inherent to the tree.

(*b*) *Environmental Factors*.—1. Natural conditions, including the climatic factors of rainfall, temperature, sunshine ; soil factors, embracing chemical, physical and biological properties ; and parasitic organisms such as pests and fungi.

2. Artificial factors or management factors introduced by the grower. These include soil treatment, cultural operations and manuring ; control of pests, fungal and bacterial organisms, etc. ; manual operations on the tree, such as pruning, fruit thinning, bark ringing and root pruning ; time of picking. These factors are all external to the tree, those under 1 occurring naturally and those under 2 being introduced by the grower.

(*c*) *Other Factors*.—In addition to the above factors, I should like to refer in this paper to the effects of terminal and lateral fruits, crop weight and size grading of fruits, all three being factors concerning the grower and being of importance in considering quality problems.

The ultimate quality of any crop of fruit is the resultant of the complex interaction of many of the above factors, and hence it is not surprising that it is difficult to ascertain the effects of individual factors in orchard practice. It is, however, by no means a hopeless task to attempt to determine the nature of certain of these factors, since, as will be shown later, several of them produce dominant effects when introduced.

This latter fact also enables the grower to utilize such factors in attempting to alter quality in any desired direction.

The Effects of Individual Factors.

(*a*) Materials.

Classes of Fruits.—I do not propose to discuss this point at length. It is sufficient to point out that the term " quality " implies different properties in the case of different classes of fruits, and hence each class of fruit must be considered from the viewpoint of the special meaning of " quality " associated with it.

Varieties.—Since it is customary to interplant varieties of the same class of fruit, it may be well to point out the differences relating to quality which are involved in the different varieties. For example, in Apples, most culinary varieties require fairly " high nitrogen " conditions to produce large, green, juicy fruits, whilst a red dessert variety like 'Worcester Pearmain' can only attain its highest quality under conditions of " low nitrogen" supply. The differential responses of varieties to rootstocks or to deficiencies of nitrogen, potassium or magnesium, accompanied by different effects on fruit quality, can easily be demonstrated.

Rootstocks.—Those who are familiar with the appearance of Apples grown on Malling No. IX rootstock and on strong rootstocks, such as Crab, will know that the fruits differ in appearance and taste, those on Malling IX being usually more highly coloured and sweeter, and often larger. When, however, fruits from other rootstocks are compared with each other, it becomes more difficult to observe differences and to state that a given stock produces fruits with the special qualities a, b, c, etc. Nevertheless, in such cases, experiments have shown that significant differences in quality do occur, but the problem is rather complicated, due to the fact that different rootstocks respond differently to differing environmental conditions.

In an experiment at Long Ashton (1),* using 'Worcester Pearmain' and 'Lane's Prince Albert,' each on twelve rootstocks and with the crops from four seasons, the following results relating to chemical composition were obtained :

Worcester Pearmain.—Significant differences due to rootstock effect occurred for nitrogen, acidity, sucrose, total sugars, total ash, phosphorus, dry matter.

Lane's Prince Albert.—Significant differences for nitrogen, acid, reducing sugars, total sugars, potassium, phosphorus, dry matter.

The differences were not large, there being generally only two significant groups, but they were quite definite.

Further interesting differences in the storage properties of fruits due to rootstocks will be observed in the following Tables I and II.

TABLE I.

Showing Effects of Rootstocks and Manuring on the Development of Rots in Cold Storage, 1° C. Season 1933. Variety, 'Worcester Pearmain.'

Rootstock.	Showing % Rots under Various Manurial Treatments.				Totals of Percentages each Rootstock.	Totals expressed as % of Lowest Total.
	No Manure.	Nitrogen.	Potash.	Nitrogen and Potash.		
	%	%	%	%		
Malling No. I.	14	7	27	49	97	211
,, II.	15	38	28	49	130	283
,, III.	14	28	31	49	122	265
,, IV.	9	38	61	44	152	330
,, V.	8	6	11	21	46	**100**
,, VI.	9	45	17	48	119	259
,, VII.	20	49	42	75	186	404
Totals of Percentages each Treatment . .	89	211	217	335		
Totals as % of Lowest Total .	**100**	237	244	376		

* Figures in brackets relate to the reference

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TABLE II.

Showing Effects of Rootstocks and Manuring on the Development of Storage Breakdown (Flesh Breakdown and Core Flush) in Cold Storage, 1° C. Season 1933. Variety, 'Worcester Pearmain.'

Rootstock.	Showing % Breakdown under Various Manurial Treatments.				Totals of Percentages each Rootstock.	Totals expressed as % of Lowest Total.
	No Manure.	Nitrogen.	Potash.	Nitrogen and Potash.		
	%	%	%	%		
Malling No. I.	10	17	5	48	80	127
,, II.	20	45	3	30	98	156
,, III.	13	15	21	39	88	140
,, IV.	7	43	38	44	132	210
,, V.	7	34	3	35	79	125
,, VI.	16	25	2	20	63	**100**
,, VII.	8	30	41	79	158	251
Totals of Percentages each Treatment . .	81	209	113	295		
Totals as % of Lowest Total .	**100**	258	140	364		

It will be evident from inspection of the two tables that significant differences due to rootstocks occur both in respect of rots and breakdown and that the relationships among the stocks may differ under the different manurial treatments. This latter point is also clearly seen in the appearance of the fruits, whilst a striking case relating to breakdown with the variety 'Bramley's Seedling' has been previously reported (2).

Age of Tree.—Fruits from young trees are usually abnormally large and very susceptible to physiological troubles and rots, the former whilst both on the tree, *e.g.* Cork and Water Core of Apples, and in store after picking, *e.g.* Bitter Pit, Flesh Breakdown, etc. This has been the common experience of investigators in various regions of the world.

The composition of young fruits shows the interesting abnormality of a relatively high nitrogen in conjunction with a relatively high sucrose.

(*b*) ENVIRONMENTAL FACTORS.

Climatic Factors.—It is very difficult to attempt to assess the effects of various climatic factors in orchard experiments, since the individual factors cannot easily be segregated but act as part of a complex. For example, in this country, seasons of high temperature are usually also dry and deficient in rainfall, whereas years of low temperature are generally also wet. It is quite easy to show, however, that seasons with outstanding features of temperature, rainfall, etc., profoundly influence the characters of fruits.

TABLE III.

Showing Seasonal Effects on Composition of Apples. Variety, 'Allington Pippin.' Season 1931, *dull and wet;* 1933, *hot and dry.*

Treatment.	1931.			1933.		
	Dry Matter.	Acidity.	Total Sugar.	Dry Matter.	Acidity.	Total Sugar.
	%	%	%	%	%	%
3 bud	13·4	0·73	10·23	17·5	1·175	12·20
5 ,,	13·5	0·75	10·29	17·0	1·065	12·26
B	11·9	0·72	9·41	16·0	0·940	11·48
D	12·7	0·68	9·84	17·3	1·020	11·70
F	13·0	0·60	9·80	17·4	1·105	13·06
H	12·4	0·74	9·54	16·9	1·135	12·08
J	13·0	0·71	10·04	16·1	1·075	11·60
L	13·4	0·75	9·91	—	—	—
Q	13·4	0·80	10·01	—	—	—

In Table III the differences in three constituents of the Apple which are readily affected by sunshine are shown for the variety 'Allington Pippin,' growing on plots at Long Ashton in 1931 and 1933, when other factors likely to produce changes were reasonably constant. In 1931, the fruits were of dull, russetted and unattractive appearance, whilst in 1933 they were very attractive and of excellent dessert quality. The two crops also behaved very differently in cold store, the fruits in 1931 showing much breakdown in the core region (*i.e.* Core Flush) and those in 1933 breaking down almost entirely in the flesh region (*i.e.* Flesh Breakdown).

The manner in which climatic factors may affect storage qualities is admirably shown by the behaviour of the Apple variety 'Worcester Pearmain.' In years of normal sunshine it is quite exceptional for this variety to exhibit any form of breakdown in cold storage. In years of abnormally high sunshine, however, when the dessert quality of the variety reaches its highest peak, the fruits show considerable flesh breakdown if kept in cold store until the end of storage life.* Results obtained with the variety from plots at East Malling in the season 1933 are given in Table II. In 1932, breakdown was negligible in all samples from the same plots, Stocks I, II, IV and V, under the four manurial treatments shown in Table II, being tested.

Whilst in this country seasons of abnormally high sunshine are associated with fruit crops of the highest quality, there is one aspect of high temperature which requires mention.

Abnormally high temperatures may bring about various "physiological breakdowns" in Apples, such as the various forms of Cork, known as Drought Spot, Internal Cork, Crinkle (sun scald) and Blotchy Cork; and Water Core and Bitter Pit. These troubles were of common occurrence after a prolonged dry period in 1929, after heat waves in 1930 and 1932, and in the abnormally hot, dry season of

* Jonathan Spot also occurs on this variety in such seasons.

1933. The relationship of these troubles to high temperatures has been previously discussed (3).

Soil Factors.—The effects due to soil are closely associated with climatic conditions, cultural practices and manuring, and it is very difficult to generalize regarding soil effects. In wet districts the highest dessert quality fruit will usually be grown only on light soils in dry situations, whilst in dry areas the lightest soils may have to be avoided because in drought years they fail to mature the crops. Tests made on Plums from the Evesham area in wet and dry seasons showed that in the former the best quality Plums came from light soils and in the latter from the heavy clays.

Many soil effects are purely chemical, and when these are altered by manurial or cultural treatments, the characteristic effect may disappear, *e.g.* potassium deficiency by manuring; iron deficiency or excessive nitrogen by grass culture.

Cultural Practices; Grass and Arable Effects.—Cultural systems in orchards vary between the practices of clean cultivation and of permanent grass sward with or without grazing. The main practical differences between these two extremes lies in their effects on soil moisture—with accompanying temperature changes—and the soil nitrogen supply. Other differences doubtless exist, and it has been shown that grass culture may alter conditions of potassium (4) and iron (5) supply.

Undoubtedly the most striking difference between the two systems is that of nitrogen supply to the tree. A system of grass culture greatly lowers the nitrogen content of the fruit, producing in extreme cases typical nitrogen-starved fruits. The fact that nitrogen content of the fruit can be readily varied by cultural treatment is of tremendous importance to the fruit grower, since it provides him with a ready means of regulating quality. Experiments at Long Ashton have shown how potent is a system of grass culture in regulating fruit quality and nitrogen supply, since it has been found in many cases that nitrogen status under a system of clean cultivation, without the addition of nitrogenous manures, is higher than under a grass system, where the grass is cut and allowed to rot and, in addition, nitrate of soda or nitrate of lime is applied annually in spring at a rate of 5 cwts. to the acre.

Manuring.—In discussing the action of manures on fruit quality, it is necessary to consider the kind of manuring practices, whether dung, complete artificials or fertilizers containing single manurial elements, such as nitrogen, potassium or phosphorus, are used. Moreover, the condition of the tree must also receive attention, especially as to whether it is already vigorous and well supplied with food or whether it is deficient in one or more elements. Finally, manurial effects are intimately related to other factors, such as drought, wetness and cultural systems.

It has already been mentioned that a grass system of culture induces nitrogen deficiency, and thus it will be obvious that whereas the effects

of a heavy dressing of nitrogen under arable conditions may produce a very large effect, under grass it may only result in very slight alteration of quality.

In Tables I and II effects of three manurial treatments, nitrogen only, potassium only and nitrogen plus potassium, on rots and storage breakdown of 'Worcester Pearmain' are shown.

In this case it is evident that both nitrogen and potassium are limiting factors to growth; both elements singly increase both rots and breakdown, and together they produce much larger effects than when used individually. The effects of the treatments are also evident in the size, colour and dessert qualities of the fruits and also their chemical characters. Thus "no manure" and "nitrogen only" fruits are small; "no manure" and "potassium only" fruits are highly coloured and of the highest dessert quality. Fruits from both nitrogen treatments show high nitrogen content, whilst the "no manure" fruits are markedly low in acid.

When a substantial response in a fruit crop is obtained from nitrogenous manuring, the main effects are as follows: fruit size is increased, red flush is decreased, ground colour becomes greener, flesh is less white, firm and sweet, and is more juicy; keeping quality is poorer both as regards rots and physiological breakdowns. "High nitrogen" fruits are usually of superior culinary quality, but highest dessert quality is frequently associated with relatively low nitrogen conditions. Failure to obtain normal responses to nitrogen are usually due to abnormally low cultural conditions or to potassium deficiency.

The effects of potassic manuring appear to be very complex. In the course of our experiments many comparisons have been made between fruits from potassium deficient trees and comparable "high potassium" trees, and between trees starved from potassium and others which have been heavily manured with potassic manures, and, as a result, have been converted into vigorous "high potassium" trees.

The main points associated with potassium-deficient Apples are as follows: they are small, usually of green, immature appearance, and do not colour up in store; in some cases, however, notably of 'Bramley's Seedling' and 'Bismarck,' potassium-deficient fruits may be of slightly higher colour than the "high potassium" fruits; colour may be markedly increased by potassic manures with varieties such as 'Worcester Pearmain' or 'Newton Wonder,' whereas on the same plot, the treatment to 'Bramley's Seedling' may convert a slightly flushed, dwarfed type of fruit into a large, green specimen. The deficient fruits may be slightly sweet, sub-acid and woody, and lack fullness of flavour; in chemical composition they show normal nitrogen content, generally low total acid, low ash content and low potash. In store they remain of immature appearance, shrivel severely and usually show low rots; breakdown is generally low in ordinary temperature store (exceptions have occurred), but in low temperature store, at 1° C., the deficient fruits may break down much more severely than comparable high potassium fruits, pointing to the fact that the

deficient fruits are injured by low temperatures. The fruits also have a tendency to breakdown in the flesh region when the high potassium fruits normally exhibit Core Flush.

No opportunity has yet occurred of examining the effects of phosphorus deficiency in the field, since no case of it has been so far observed. In pot culture experiments, phosphorus-deficient fruits have been shown to be of dull, slightly bronzed, unattractive appearance, soft to pressure, sharply acid and lacking pleasant aroma and sweetness.

In an experiment where dung has been tested, used at a rate of twenty tons to the acre per annum, on the Apples ' Grenadier ' and ' Bismarck,' the effects have been somewhat similar to those produced by a complete manure containing nitrogen, potassium and phosphorus, the produce being excellent culinary specimens of moderate keeping quality. In most situations the use of such large dressings of dung would doubtless lead to poor keeping quality in Apples.

Pruning.—Pruning treatment usually ranges between the extremes of practically no pruning to detailed spur-pruning systems. The main differences which occur in practice may be illustrated by a comparison of fruits of the variety ' Allington Pippin ' grown under systems of " regulated " pruning—*i.e.* light leader tipping and some branch thinning—and winter " spur "-pruning. The effects of the two systems are most readily seen in years of heavy crops and are not so obvious when light crops are borne. The spur-pruned fruits are relatively large, and are of more attractive appearance than the " regulated " fruits and dessert quality is high, whereas in the " regulated " crop there are many fruits of only moderate dessert quality. The main difference in chemical composition between the two groups is that the " spurred " fruits show relatively low reducing sugars combined with relatively high sucrose content, the " regulated " fruits only approaching this condition when crops are light.

In cold store, where low temperature breakdown occurs, the " spurred " fruits tend to show a relatively high proportion of fruits with Flesh Breakdown, whereas the " regulated " fruits show more Core Flush, especially in heavy cropping years.

Fruit Thinning.—The effects of fruit thinning on quality are in the same direction as spur pruning in relation to regulated pruning, but in most of the experiments carried out on thinning, the results obtained have not been so clear as those from spur pruning. It seems evident that very drastic thinning is required to produce large effects on chemical composition and especially on storage properties. In 1931, a very drastic thinning treatment was carried out on two 'Bramley's Seedling' trees and the crops compared with those of comparable unthinned trees. Actually, 1,270 fruits were removed from the two thinned trees at an early stage and the treatment resulted in the production of larger proportions of large fruits in the total crops but substantially less total crops, viz.:

Unthinned Trees	337 lb.; 231 lb.
Thinned Trees	189 lb.; 148 lb.

The thinned fruits showed the usual relatively low reducing sugars with relatively high sucrose and behaved in store as regards breakdown as would be expected from the comparison of a light crop with a heavy crop—*i.e.* thinned fruits gave higher total breakdown and of the flesh type in preference to Core Flush—figures for April 22 were as follows :

Thinned.—Total breakdown, 100 per cent. ; all flesh type.
Unthinned.—Total breakdown, 28 per cent. ; 10 per cent. Core Flush ; 18 per cent. flesh type.

Bark Ringing.—Bark ringing is a very potent method of altering the quality of fruit. The main effects are as follows :

Fruit size may be either increased or decreased, depending on moisture conditions, effects of treatment on crop weight, etc. ; colour is greatly increased ; the flesh is hard, white and less juicy ; flavour is rendered sweeter and dessert quality usually greatly improved, but culinary properties decreased. Chemically, the salient points are a substantial decrease in nitrogen content and an increase in sugar content. The general effects above are thus similar to those resulting from a limited nitrogen supply. The storage properties are peculiar. In ordinary temperature store keeping quality is not usually appreciably affected, unless rots be decreased, whilst if there is a Bitter Pit problem this may be affected, either an increase or decrease resulting. At low temperatures "ringed" fruits are very poor keepers, being susceptible to Low Temperature Flesh Breakdown, *e.g.* in 'Bramley's Seedling,' and to Superficial Scald, *e.g.* in 'Newton Wonder.'

Ringing frequently alters the position of the normal breakdown when this is Core Flush, such as in 'Newton Wonder,' causing the fruit to scald, and this being followed subsequently by breakdown in the flesh region.

It will thus be seen that, as regards storage properties, "ringed" fruits differ radically from the fruits of similar appearance produced by low nitrogen conditions, in the latter case storage properties being excellent in all respects.

There is a further unfavourable effect which ringing may cause whilst the fruit is still on the tree. If "ringed" fruits are subjected to high temperatures or to drought conditions they are very susceptible to "cork" troubles. This has been noted in several instances, and some figures obtained in a case at Long Ashton, variety 'King Edward VII,' in 1932, when several heat waves occurred, will serve to illustrate how serious the effect may be.

	Complete Ring.	Two Half Rings.
Total number of fruits harvested	1754	2595
Sound fruits	39·5 %	42·7 %
Slight Cork	6·8 %	11·3 %
Severe Cork	53·7 %	46·0 %

Root Pruning.—Only two experiments have been carried out on this subject—with 'Bramley's Seedling' and 'Newton Wonder'—

and the results have been similar in every way, *i.e.* appearance of fruits, chemical qualities and storage properties, to those obtained by bark ringing.

Time of Pick.—In experiments on this subject, it has been usual to compare fruits picked prematurely with others picked at the date considered by the grower to be correct. No extra late pickings have been made.

It has been usual to observe that the later picked fruits were of superior appearance when compared with those of the earlier picks, being often appreciably larger, brighter in the skins, and more highly coloured. On keeping, the early picked fruits have usually shrivelled severely and have not developed full flavour. Chemically, the main difference observed has been the increased sugar content of the later picked fruits.

Results of storage tests have shown some anomalies. Thus, where Bitter Pit has occurred, it has not generally been more prevalent in the early picks, but often the reverse has occurred. Again, breakdown has sometimes been more severe in the early picked fruits. However, it has been usual to find that early picked fruits are susceptible to Superficial Scald and that Flesh Breakdown is more prevalent in later picked fruits, whilst in certain cases the additional point has been observed that whereas Core Flush occurred in the early sample, the main form of breakdown was in the flesh in the later picked fruits, a result in accordance with the fact that the better type of fruit often shows Flesh Breakdown when the poorer type exhibits Core Flush (see under pruning, thinning, bark ringing and size grading).

(*c*) OTHER FACTORS.

Terminal and lateral fruits.—These terms are applied to fruits developed from the terminal and lateral flowers respectively of the blossom cluster. The two types of fruits differ appreciably in several ways and are worthy of distinction by the fruit grower. Terminal fruits are generally inferior to lateral in quality. They are longer in shape and rather more juicy and "thinner" to taste. Chemically, they usually show lower dry matter and sucrose content than laterals when examined immediately after picking, but during storage they lose sucrose at a slower rate than the laterals (6).

They appear to be more susceptible to rots in store than laterals, but no difference has been observed between the two types of fruit in respect of susceptibility to storage breakdowns.

Size of crop.—Light crops usually consist of relatively large fruits, and thus when fruits from heavy and light crops are compared, the comparison is generally between fruits of unequal size. The relative characters of the two kinds of fruit are similar to those already described of fruits from "regulated" and "spur pruned" trees and of "unthinned" and "thinned" trees, the light crop fruits being similar to the "spur pruned" and "thinned" fruits. Thus the light crop fruits tend to show high sugar content, especially of sucrose, are frequently

poor keepers and often tend to break down in the flesh rather than in the core region.

Size Grading.—In the grading by size of the fruits from any tree, many other properties of the fruits are automatically graded. Thus, if the fruits are examined chemically, it will be seen that there is a definite downward gradient from large to small in sucrose, ash content and potash, both in fresh weight and in ash, whilst reducing sugars may show a gradient in the opposite direction. Again, the largest fruits are generally juicy and of good flavour, whilst those in the smallest grades lack juice and flavour and are "woody." In store gradients are again often observed, the largest fruits being often most susceptible to rots and to troubles such as Bitter Pit. Lastly, it often occurs that whereas breakdown is most prevalent in the flesh region in the larger grades, in the smaller ones Core Flush is the predominating form of breakdown.

(The points made in the various sections of this paper were illustrated by data on lantern slides. See also Reference No. (2) for tabular matter.)

REFERENCES.

(1) WARNE, L. G. C., and WALLACE, T.: "The Composition of the Terminal Shoots and Fruits of Two Varieties of Apple in relation to Rootstock Effect." (To appear in the *J. of Pomol. and Hort. Sci.*)

(2) WALLACE, T.: "Factors influencing the Storage Qualities of Fruits." (*Proc. 1st Imperial Hort. Conf.*, Part III, London, 1930.)

(3) WALLACE, T.: "High Temperature Injury on the Growing Apple." (*Gardeners' Chronicle*, Vol. 92, p. 433, Dec. 10, 1932.)

(4) WALLACE, T., and PROEBSTING, L.: "The Potassium Status of Soils and Fruit Plants in Some Cases of Potassium Deficiency." (*J. of Pomol. and Hort. Sci.*, Vol. XI, No. 2, June 1933.)

(5) WALLACE, T.: "Investigations on Chlorosis of Fruit Trees. IV. The Control of Lime-induced Chlorosis in the Field." (*J. of Pomol. and Hort. Sci.*, Vol. VII, No. 4, June 1929.)

(6) HINTON, J. C.: "Further Observations on the Influence of Position in the Cluster on the Quality of Apples." (*Ann. Report, Long Ashton Research Station*, 1931.)

Mr. T. N. HOBLYN, East Malling Research Station.

MAY I first say how sorry I am that Mr. BANE is unable to be here to open this discussion. I have come from East Malling to take his place. The first thing I would like to do is to thank Dr. WALLACE for the exceedingly lucid way in which he has explained to us an enormously difficult and complicated subject.

In Dr. WALLACE's paper there are two main points which strike one most forcibly. The first point is the amazing complexity of the science and practice of fruit growing as we understand it to-day. The second point is the extraordinary value of co-operation between grower and research worker in getting more knowledge as we go on. Until recently we have been, I suppose, in this country rather more concerned with the exterior appearance of our apples than with the interior. We have tried to grow an apple which shall be the right size, nicely coloured, of good appearance, nice finish, and which will

be attractive to the purchaser. We have tried to grow highly coloured dessert apples as a rule, and the size should be probably not too large or too small; and we have tried to grow a large green cooking apple. I think to a certain extent we have learned how to do it, either as a result of bitter experience on the part of the grower, or as the result of carefully planned research work. That is where soil surveyors have done valuable work. We have learned something of the soils of this country on which we can grow fruit, and it seems to me an extraordinary thing on what a wide variety of soils we can grow fruit.

On a recent tour of Essex and Suffolk a month or so ago I saw 'Cox's Orange Pippin' growing on a wide range of soils, as different as those at Malling, Wisley and Sussex, sometimes in Essex, almost in the same plantation. I saw good 'Cox's Orange Pippin' on all those soils, and it seemed to me, provided the grower knew his job he could do this. It did not necessarily always pay him to do it, but it could be done. That is the result of an amazing accumulation of knowledge on the management of fruit.

We at East Malling have been working on the management of fruit planations for 21 years now, and it is rather interesting to follow the way that knowledge has gradually accumulated. I am quite certain much of it has been learned by growers from their own experience at the same time, but we have contributed our little bit to it.

We started with the root stocks and we sorted them out. We found there was a range of root stocks that had certain general characteristics, some gave big trees, some small, some gave early cropping and some delayed cropping, and we very soon found this was not a simple subject. The value of root stocks would be different with different varieties. In some cases, in pears and plums, the variety would refuse to grow on a particular root stock altogether, and there were certain quite definite preferences in apples.

At the same time we were studying pruning and we very soon found in pruning you could not lay down any general rules for apple trees, one variety had to be pruned in one way and another variety in another. Going a little further we found the same variety on a different root stock might need different pruning. It was quite obvious you could not prune trees on such different stocks as No. 9, No. 2 and No. 12 in the same way.

Then we came to the question of manuring and we soon found that complications started again there. Trees on different root stocks required a different manuring or cultivation in order to get the right result. In this connexion the figures Dr. WALLACE has given of the keeping quality of the Worcester at East Malling on our own root stock manuring trials are exceedingly interesting. Two particular stocks I would like just to pick out as being of special interest. One is No. 5. No. 5 under ordinary growing conditions at East Malling, that is to say, under cultivation on a rather high nitrogen soil, has always given us exceedingly poor results, the crops have been low, the fruits small, poorly coloured and of poor appearance Yet on one

particular plot at East Malling which for fifteen years has had no manure, the fruit on No. 5 is not very much smaller than upon other root stocks growing under the same conditions. On the plot next door we have No. 5 growing under grass and here under low nitrogen conditions under grass the fruit colour is not unduly poor. It is as well coloured as the other fruit growing on other root stocks. There is a case where we got evidently a root stock that wants a low proportion of nitrogen and needs a higher proportion of potash.

Take a stock like No. 4. That is a stock Dr. WALLACE tells us breaks down early in store. On that particular manurial trial there are trees of No. 4 under the four different manurial conditions: no manure; potash only; nitrogen only; and nitrogen and potash. Incidentally, those manures have been given during the last four years in very large quantities, so these treatments are very broadly different, yet the cropping of the trees on stock No. 4 still shows very little difference due to manure. Actually at the present time after fifteen years without any manure at all, the trees on the "No Manure Plot" on No. 4 are still yielding a higher crop than those under any other treatment. That does not mean to say these trees are necessarily in good condition on the "No Manure Plot." They are not, they have naturally suffered very markedly, and the trees which receive both nitrogen and potash are growing stronger. But the fruit has gone on, and if we only take the crop as a criterion we should say there had been no effect of manuring on root stock No. 4. So much for the interaction of manuring and root stock in one variety, and if we take different varieties we get different results.

Then we have learned that these results differ on different soils. On certain soils the whole effect is telescoped so that there is not much difference between the intermediate varieties of root stocks; on other soils the thing is spread out so that the differences are magnified. Again, similarly we get complicating factors under different weather conditions.

As a result of all these complex interactions we built up the modern trials of to-day which are designed to meet the complex requirements of the grower; these are undoubtedly very complex and should take in all these factors. We used to think of pruning experiments, or manuring experiments, or root stock experiments. Nowadays we have one big experiment in which everything is covered.

So we arrived at these very complex modern experiments which were designed to produce the right-looking apple. But Dr. WALLACE goes further. He says that is all very well, you can take a lot of trouble and produce the apple that looks right, but the way in which that apple is built up is exceedingly important from the point of view of storage. So we have got to learn, not only how to grow the best-looking apple, but how to grow the apple that will keep. I think it is to these storage problems that we have got to look for our most important work during the next decade. On every side we see people planting fruit, and presumably they hope in time to capture the

market of this country for home-grown fruit. To do that they have to produce apples at any time of the year just in the right condition and put them on the market when the market is ready for them. So I think we have got to pull together, the whole lot of us, the research worker, the grower, the storage expert, and anybody who is interested in the industry.

That brings me to my second point in Dr. WALLACE's lecture, the value of co-operation. I think Dr. WALLACE's own results are a wonderful example of co-operation. A great many of us have probably contributed fruit to Dr. WALLACE's experiments, because the paper here given is the result of co-operation from a number of sources. I think we have got to continue to work together even more closely than we have done before if we are going to achieve our object, which is to capture the markets of this country for home-grown produce.

Mr. W. P. SEABROOK, Chelmsford.

DR. WALLACE quite rightly judges the policy of orchard management by the effect of cold storage on the product. The average grower, however, has another target. He aims at quite a different thing primarily, but it does actually pan out to be the same thing in the end. He aims at regular crops, sound texture and good colour, and these three things turn out to be the same target as Dr. WALLACE is aiming at when he demonstrates these results in his cold storage experiments.

I would like to discuss those parts of his lecture which he calls natural conditions. Most growers have a fairly good working knowledge of manuring, spraying, and what he calls the artificial factors of management. That can be done according to the skill, observation powers, equipment, and knowledge of the operator. But there are natural conditions which are far more difficult to deal with. Those I might mention are rainfall, temperature, sunshine and soil factors. All these things were termed years ago " acts of God " and considered as beyond the grower's control. We regarded weather, frost, rain, snow, blights and things like that as something we could not help. Thanks to modern research and the awakening of the average grower, he is not content to sit down and put up with such troubles as extra rainfall or extra sunshine. He wants to try to ameliorate the conditions which those troubles used to cause in the past. I think Dr. WALLACE is perfectly right when he says one can ameliorate those natural conditions by various practices. For instance, in the case of rainfall—if you happen to be in a high rainfall area there are many ways of counteracting the effects of excessive rainfall. I think probably 30 inches a year spread evenly over the year is about as much as apples will comfortably stand, and probably for dessert apples 20 inches is better. One usually finds rainfall is high or low in accordance with the quantity of sunshine. That is to say, a dry area generally has more sunshine than a wet area. Therefore, the former

appears to be more suitable for the production of dessert apples. If you have excessive rainfall, it generally means more nitrogen, excessive wood and leaf growth, excessive size of fruit, bad storage ability, and what is worse still, immature flowers next year, which will not stand up to an unkind spring.

Drought means the reverse of all these, but both conditions can be ameliorated by cultivation and/or non-cultivation. It is a course which we have followed for over twenty years now, between the extremes of high cultivation on the one hand and on the other hand, total grass. That is, partial cultivation which can be carried out in two ways: first, by allowing grass to grow in the tree rows and cultivating between the tree rows; and secondly, by cultivating only the first half of the year. We have got to have a pliable method of management of the soil in order to counteract excessive rainfall and excessive drought. The last two years have taught growers a great deal about drought. We find that in a year of heavy rainfall, in order to get good texture, good colour and regular crops, and, of course, equally well the right storage ability, we must do less cultivation. By less cultivation we reduce the nitrogen by allowing weeds and grass to grow in the second half of the year. By that means we can counteract to a large extent the effects of excessive rainfall. Conversely, we can to a large degree counteract the effects of drought by continued cultivation over a much longer period and by adding nitrogen. This last season in particular has been very interesting from that point of view. We found that grass is much too drastic a treatment under these drought conditions, but if we applied four or five hundredweights of nitrate of lime to the acre, when one saw the drought persisting, even in grass orchards it would pull an apple crop through. It is only where you have a light soil that this dressing alone will not do it, and one has to break up the soil eventually. With regard to the question of orchards under grass we get infinitely more drying out on the heavy soils than we do on the light soils. I do not know why it is, but it has been most marked this year. In any case the grower has to aim at a pliable method of cultivation, so that he can switch over very quickly from weeds or grass which he uses to counteract a high rainfall, to more cultivation, less grass and weeds, and by adding nitrogen to counteract a drought. Of course it is far easier and better for the grower to have an insufficient rainfall—it is much easier to control the conditions arising therefrom.

With regard to temperature, I shall never forget August 1933. We had exceptionally high temperatures and heavy thunderstorms, and I think no policy of cultivation or non-cultivation would counteract the effects we had then. The breakdown in apples was very marked; Cork was worse than we have ever known it before. But normally, with a moderate rainfall such as we get in this country, luckily an inch or two a month, we can avoid nearly all those troubles, and by manipulating our cultivation we are able to bring about the regular crops of sound texture and colour which we want so much.

I quite agree with Mr. HOBLYN on the question of soil. Our experience is that soil matters extraordinarily little as long as you adapt your cultivating and manuring policy to the soil you have. It seems to us that the criterion we should use in judging and diagnosing the health of a tree is the leaf. We have come to the conclusion that as long as we have a good dark, broad leaf, well spaced, not too large and not too weak, and well maintained, we can get very much more regular crops than we have been able to do in the past. Naturally pests and fungus troubles have to be kept down rigorously. It is no good having a good leaf and allowing aphis, caterpillars and scab to destroy it.

The item of texture follows on what I have just been saying, it is impossible to get good texture without adjusting the rate of growth of the tree. That seems to us most easily done by varying our cultivation practice. All these things, regularity of crop, texture, and colour which the grower aims at, lead up to the same criterion, the storage ability. If one has normal crops of fair texture and fair colour then one gets quite a good storage condition. A very important factor has come into the industry, that of cold storage, and we have to learn the natural laws and follow Dr. WALLACE'S work at Long Ashton with regard to the best conditions.

We used to aim at a big apple in the old days. We were not so concerned with the storage qualities of that apple. But nowadays we have to go further than that, because the market is heavily over-supplied with apples which will not keep, which come along in the middle of the season, and we have to take steps to see that at least the larger portion of our crops is capable of being stored for some months longer. Since we gave up clean cultivation, for good and all, I hope, 'good husbandry' as it used to be called, and allowed grass and weeds to grow, we are able to "dry off" the tree. It develops and hardens the fruit buds, and we invariably get very much stronger blossoms the following year. Although the blossom buds are differentiated in June it does not follow they will reach the fruiting stage. The effects of excessive rain must be reduced or the effects of drought corrected. By adopting this pliable method of cultivation or non-cultivation many growers have been able to bring about a very much better result, better texture, better colour, and better storage ability.

One thing I would like to say, in passing, about nitrogen. I think we ought to make far more use of nitrogen. Nitrogen and grass seem absolutely incompatible. One has an opposite effect to the other. It is like driving a car with the brake on. At the same time one has to have the driving force of nitrogen and has to have the brake available. One need not use either, but we have to have both these things at hand, so that in the event of our nitrogen supply being excessive owing to the heavy rainfall, we can allow grass and weeds to grow, that is, putting on the brake and reducing the effect of that heavy rainfall.

In that connexion also we have the problem which Dr. WALLACE

mentioned of the differing needs of different varieties. One particular case stands out in my own experience which is a painful one. We have 'Worcesters' and 'Cox's' growing in the same orchard. There is no more incompatible pair than 'Worcester' and 'Cox' as regards every need except pollination. They do cross pollinate, but they need different spraying, different pruning, different manuring and different cultivation. That is why we have swung over in recent years to one variety in one section, so that we can manure, cultivate and work that section in accordance with what the main variety needs. That makes an enormous difference and it is very much easier to bring about the natural conditions which are so essential to successful storing.

Secondly, with regard to the question of varieties, we made the mistake years ago of planting cooking with eating apples. Cooking apples need quite a different cultivation policy, and now we have adopted the policy of one variety one section as has been followed in America for a great many years.

I would just like to corroborate Mr. HOBLYN'S remarks with regard to the co-operation of grower and research worker. That is a post-war condition which has been extremely valuable to everyone getting a living by growing fruit. The more we can get together, the more the scientist can see and recognize the problems of the grower, and the more the grower is able to benefit from the research work of the scientist, the better it will be for the English fruit growing industry, and that industry will continue to make very much quicker progress than it has made up to now.

Mr. W. G. KENT, Maidstone

IF I am at all a normal person many of you will be in the position I was when I first heard Dr. WALLACE tell his story. I have heard it from the platform on at least seven different occasions. Of course he adds a little each time, but on the first occasion I heard him my feeling was one of bewilderment. The factors were so numerous that I felt it would take years to sort them out in such a way that one could make use of them in commercial practice. But after further thought and experience in the field it seems to me the problems are not quite as hopeless as the beginner might suppose.

Dr. WALLACE said many of the environmental factors produced powerful or dominant effects, and further, several of them tend to operate in one direction and several in entirely the opposite direction. For instance, there are a number of factors which behave in a similar way towards the apple in particular, manuring with nitrogen, clean cultivation, high soil moisture, hard pruning, a wet climate, a light crop and a heavy thinning of the fruit. In addition to these we have the young tree effect and the 'King' fruit. On the other hand—I hope I shall be corrected by Dr. WALLACE if I make any mistakes—we have the effect of grass, little or no manuring with nitrogen, a dry, poor soil, an old tree as opposed to a young tree, a heavy crop and a dry climate. Those all tend more towards the low nitrogen condition

and therefore a high colour, and usually better quality fruit, more especially of dessert varieties.

It seems to me that modern practice must take into account, not only a single problem such as grass versus clean cultivation, but those factors which tend towards either the one or the other type of fruit. As far as I can see in commercial practice to-day one cannot juggle from year to year with the potash content of the fruit. We find in practice it may take a considerable period of years to add potash to the soil in sufficiently substantial quantities to produce the desired effect. Therefore we cannot raise or lower from year to year the quantity of potash in the soil. One ought to put a substantial amount upon the soil from the beginning of the plantation, even before, if possible. The potash question is most important. In my work in Kent I have to visit commercial fruit orchards. I have been doing it for four or five years, and I have a map in my office on which I put the name of every town or village in which I find potash deficiency symptoms in apples. I have got well over a hundred names. Practically every fruit growing district of Kent figures on that map, embracing practically every town and village in Kent where fruit is grown substantially. I say the fruit grower has got to avoid any possibility of discovering, when the tree is growing up, potash deficiency, because it may take him anything from three to five years of potash manuring to put it right.

But when it comes to the nitrogen level in the tree, that can be varied comparatively easily from year to year. You have to look at the appearance of your fruit and at the foliage of the tree, and make up your mind as to whether you ought to have more nitrogen or less. With dessert apples it is frequently found that lower nitrogen conditions are desirable to produce more highly coloured fruit of better dessert quality. The methods by which that can be done are several, but the principal one, of course, is the grassing down of the plantation, or the partial grassing down suggested by Mr. SEABROOK. As he said, there is a wide range between perfectly clean cultivation and permanent grass. One commercial method is to tractor-cultivate between the rows in both directions, leaving a section of grass round the trunk of the tree, larger or smaller as the case may be, and perhaps just to mow that patch once a year. If you want to vary the nitrogen you can increase the width of the tractor cultivation, or decrease it as the case may be; or you can cease your tractor cultivation earlier in the season, or carry it on later in the season. But you should also consider the addition of nitrogenous fertilizers if required, and the pruning of the trees, hard pruning tending towards higher nitrogen and a greener fruit, less coloured as a rule; or no pruning and manuring tending towards rather smaller fruit often of a somewhat higher colour.

Differential treatment of varieties is simplified in the plantation, where, as Mr. SEABROOK suggests, one variety occupies the whole of one block except for the necessary pollinators. It is particularly important in these times to separate culinary and dessert varieties; it

is also essential to separate 'Cox' and 'Worcester.' 'Worcester Pearmain' is, I think, the commercial apple of to-day in this country which requires least nitrogen. 'Cox's' requires considerably more if one is to get the characteristic colour and flavour, and if one is to get fairly regular cropping. But even if one's plantation is mixed up, the case is not absolutely hopeless; one can give a certain amount of differential treatment to each variety. One can prune the 'Cox' and leave the 'Worcester'; one can sprinkle nitrate of lime or sulphate of ammonia over the root-run of a particular variety, and leave it out for another variety. Management of course is easier where only one type of root stock is used for each block of fruit, Dr. WALLACE having clearly shown that the reaction of one root stock to a particular set of circumstances is not necessarily the same as that of another root stock.

There is another point, a very important one it seems to me, particularly to those who seek the best flavour in their fruits, and especially with the variety 'Cox.' 'Cox's Orange Pippin' with too low a level of nitrogen may give an exceedingly prettily coloured apple, a bright colour with a very clear, smooth skin, and an almost total absence of russet. There has been a tendency in commercial fruit shows in the last few years, it appears, to encourage that type of 'Cox's Orange Pippin,' but I think if you were to try them for yourselves, you would find that they are hard in texture, as Dr. WALLACE pointed out happens with a very low nitrogen apple. It is not only that, but they lack to a very considerable degree the typical 'Cox' flavour. To my mind the best 'Cox' to eat, and I have peculiar facilities for obtaining samples of 'Cox's Orange Pippin' for eating in my journeys round the county of Kent, is that which has a reddish-brown colour, rather than the lighter and brighter colours, and which has a distinct amount of russet upon its skin. I know a grower in Kent who has won first prizes at the Imperial Fruit Show with 'Cox's Orange Pippin' of remarkable skin quality and very bright colour. The same grower also has in his plantation 'Cox's Orange Pippin' on standard trees worked on seedling root stocks. They bear apples of considerably duller appearance with a certain amount of russet on their skin, but to my mind, there is no comparison between the eating qualities of these fruits. The show fruits winning the prize are grown on cordons on rootstocks, types 2 and 9. If I were to have my pick for my own consumption, I would unhesitatingly go to the 'Cox's Orange Pippin' of less bright appearance grown on the standard trees on seedling root stocks. If you go to the section for market packages in this show you will see four exhibits of 'Cox's Orange Pippin' in half-boxes. The First Prize—I was a judge, so I know a little as to the appearance of these fruits—goes to the 'Cox's' of a distinctly reddish-brown colouring. One of the other exhibits not so highly pointed has brighter colouring, but although the ground colour on the winning fruit may not have completely turned from green to yellow because the apple is not yet at its best, there will be a time when this fruit will be of a very much higher flavour in my opinion than the more brightly coloured ones.

One other point, it seems to me is that the public taste for green cookers is apparently right. There has been a considerable amount of criticism of the public taste for red apples, but in view of Dr. WALLACE's remarks about the high nitrogen fruit, the rather green fruit, being of a high culinary quality, the public taste which is tending to turn towards green cookers is justified.

I have a question to ask Dr. WALLACE. In his printed proof he refers to "the superficial scald which occurs in fruits picked before the normal picking time as determined by a good commercial fruit grower." In view of the fact that crops are heavy this year and there is more picking to be done, there is a tendency to pick a little earlier than one might in a lighter year. There also seems to be a tendency for apples which are to be put into cold store to be picked early. I am wondering if the superficial scald referred to is one which is capable of control by the use of oiled wrapping papers. I should be glad if an answer to that question could be given when Dr. WALLACE replies.

THE CHAIRMAN.

I AM sure you will agree that we have listened to some exceedingly interesting communications on this very complex subject. We shall all be inclined to agree with Mr. KENT, that the subject is exceedingly complex and that the grower is between the devil and the deep sea, if he is to steer a clear course between bitter pit, the various break-downs, and all the other troubles that he is likely to get. Whatever he does something may happen. Some people going away from this Conference might feel rather like the guests at a wedding where the gentleman put up to propose the customary toasts regretted that he could not congratulate the bridegroom because he did not know the bride, and he could not congratulate the bride because he did not know the bridegroom. But after all nature is complex and cannot be reduced to a few simple rules. Whether you grow apples, barley, or anything else, you are in for a complicated series of processes. If you do a certain thing, something is likely to happen, but something else will probably happen also. Things never go singly. The purpose of science is to disentangle all these various factors and to set out what the results are likely to be, and the function of the practical man is to steer a steady course through them and avoid the worst of the pitfalls. The exhibits outside, and the success of our big growers like Mr. SEABROOK, Mr. BUNYARD and others, show that the practical man can do this.

Confining ourselves simply to the factors we have been discussing to-day, there is the important factor of climate which you simply accept ; if the climate on the whole is suitable, you attempt to grow fruit ; if on the whole it is unsuitable, you do not. You can of course by various devices such as those mentioned by Mr. SEABROOK mitigate the effect of the climate, but only within limits.

Some very interesting results were given us by Dr. WALLACE about the effect of a season on quality. It is interesting to hear from him that a hot season is associated with high quality and also with a

tendency to breakdowns. He showed us the results for two years: that particular method of comparison however, is not very good, and much better methods now exist, statistical methods for finding out the relation between various climatic factors and anything that can be measured or expressed numerically, as Dr. WALLACE expresses his results. Now that Mr HOBLYN is at East Malling, we are hoping that he will be able to work out relation between sunshine, temperature, rainfall, and other factors with yield and quality in the various fruits.

In regard to the soils, fruit is fortunately very tolerant, especially the apple. Mr. SEABROOK gave us instance from his experiences in Essex and other parts of the country. The soil fulfils several functions; it supplies air to the roots which is of vital importance for adequate root growth; it supplies water and food, and it has to fulfil certain other conditions; *e.g.*, there is the question of acidity which has not been mentioned to-day, but which is nevertheless of great importance with regard to growth. The air and water supplied to the tree roots are a function of the nature or texture of the soil which is perhaps the most prominent of all its properties, and where the soil is quite unsuitable, it is far better to leave it alone and not to attempt to grow fruit on it. The task of drastically altering the soil is most costly and should not be attempted on a commercial scale. Amateur gardeners have done it, but it has meant a lot of very serious work. Fortunately the types of soil best suited for fruit trees are well known and it is possible now to form a good idea as to whether fruit is likely to do very well or whether a grower is likely to meet with trouble if he starts.

It is not possible to define rigidly what is meant by a good soil, because there is a great deal of latitude. It depends on the stock, and also on the season. You remember the interesting observation made at Evesham that the heavier soils gave the better results for plums in the dry season and the lighter ones in the wet season.

The manuring of fruit trees is a very important matter. The earlier experiments of SPENCER PICKERING at Woburn seemed to indicate the manuring had but little effect on the yield. That conclusion we now know is not correct. But the experiments showed what has been amply borne out since that the manuring of a tree is different from that of an ordinary agricultural crop. The effect of nitrogen is marked and fortunately it can be controlled. You may add to the supply of available nitrogen by giving nitrogen manures, or you can take from the supply by growing grass. That facility of control is fortunate, because as several speakers have emphasized, for some purposes you want higher nitrogen and for others you want lower nitrogen supply. That effect of grass in controlling available nitrogen was first pointed out by PICKERING at Woburn and now it has been elaborated and developed a good deal. One can attain intermediate levels of available nitrogen by methods such as Mr. SEABROOK described, or by cutting, grazing or manuring the grass, but there are indeed various devices whereby one can ensure control

and adequate reduction of the available nitrogen supply to the tree. If necessary other methods could be used; soil investigators now know a number of ways in which the nitrate content of the soil can readily be reduced. Addition of straw and chaff or easily decomposable carbohydrates, such as sugar or starch, reduces the nitrate almost to nothing in a few hours, and is indeed the quickest way we know of doing it.

I should like to emphasize the point mentioned by Dr. WALLACE and Mr. KENT, the question of potash deficiency. Mr. KENT says he knows many instances of this in orchards. Probably others here also do. There is rather a tendency to suppose that the manuring of fruit trees can more or less look after itself, and that good cultivation is about all that is needed. Mr. KENT rightly pointed out if the potash manuring is neglected and the tree allowed to suffer for a time, as it will of course, before the worst of the symptoms set in, then it takes some time to get things round again. You cannot remedy the bad effects of potash deficiency as quickly as you do those of nitrogen deficiency.

It was interesting to hear Dr. WALLACE's remarks about the insensitiveness of fruit trees, especially apple trees, to phosphate. That clearly wants further looking into, because we know most other plants are sensitive to phosphate in one form or another.

The deficiency symptoms that Dr. WALLACE has worked out are exceedingly valuable, not only to fruit experts, but also to soil experts as well in checking deficiencies in soils; this work I regard as one of the great achievements of Long Ashton, and of Dr. WALLACE in particular.

It is fortunate for us in this country that so many of our soils and such large areas of land are suitable for fruit. We can undoubtedly grow much more fruit than we are growing. There is no question also that the nation can with great advantage to health consume much more fruit than is now consumed. We all hope that the discussions now proceeding in various quarters, about the difficult question of the margin of price—the rather wide margin between what the grower gets for his fruit and what the buyer is invited to pay for it in the shop—will be to reduce this margin somehow or other so as to ensure a greater consumption of fruit than we have at present. We also hope this new industry of fruit canning will lead to a greatly increased consumption. In these days housewives seem to be wedded to canned food, and fruit can now be canned as successfully in England as anywhere else.

I must not detain you longer as the hour is late. I will only in your name thank Dr. WALLACE and the other speakers for the exceedingly interesting papers which they have given us, and also I am sure you would wish me to thank the Society for having organized these discussions and this Conference on Fruit. One of the great achievements of the Society is its educational work. Nothing can be better than to bring together those interested in the subject and give

them an opportunity of hearing men of scientific distinction like Dr. WALLACE, and men of wide practical experience like Mr. SEABROOK and Mr. KENT. In your name, therefore, I thank these gentlemen for their contributions this afternoon.

Before concluding, I will ask Dr. WALLACE to reply to the questions if he wishes to do so.

Dr. WALLACE.

I SHOULD just like to make one or two very brief remarks.

The point Mr. SEABROOK made about the effect of heavy soils—the drying out more than light soils: I think you will find that only happens after very prolonged drought.

Mr. KENT asked whether superficial scald due to early picking would be likely to be controlled by oiled paper wrapping. I should expect considerable control of this trouble by this means, but I should like to warn growers that superficial scald is not the same trouble as bitter pit, which also may follow early picking and is not controlled by oiled wrappers.

The question as to whether we should grow 'Cox's' on a large scale is a thing on which I can merely give an opinion. I should like to see 'Cox's' grown on a large scale in this country, and also one or two other apples. I would rather see that than the present-day method of growing little samples of lots of varieties. On the other hand, I do not think our other varieties will ever be lost by following such a course in a country like England where we have so many amateur growers.

There was a question about grass culture and pests. I think you will find grass culture will reduce pests, but I do not regard that as too serious a question because in these days we are out to get the best. If we cannot obtain the best under grass culture and no pests, than we must keep our plantations under cultivation and control the pests. The control of pests is probably a bigger problem than culture in any case.

The question with regard to the 'sleepy' pear, that is merely a form of breakdown.

The other point about the no manured ground is rather a point for Mr. HOBLYN, in whose charge the plots have been.

Mr. HOBLYN.

WITH regard to the question of the unmanured trees, I do not think they gave any more biennials than any other of the plots. 'Worcesters' and 'Bramleys' were grown, as we now know wrongly, together. 'Bramleys' are very biennial indeed under all treatments, 'Worcesters' are not so biennial as the 'Bramleys,' but they did show a slight tendency to grow bigger crops one year and smaller the next. They are not actually biennial bearers. I do not think there is at present any particular tendency for the unmanured trees to become biennial bearers.

FIG. 19a.—GENERAL VIEW, FRUIT TRIAL GROUND, WISLEY.

[*To face p.* 120.

Fig. 19b.—General View, Fruit Trial Ground, Wisley.

FIG. 19C.—GENERAL VIEW, APPLE TRIAL GROUND, WISLEY.

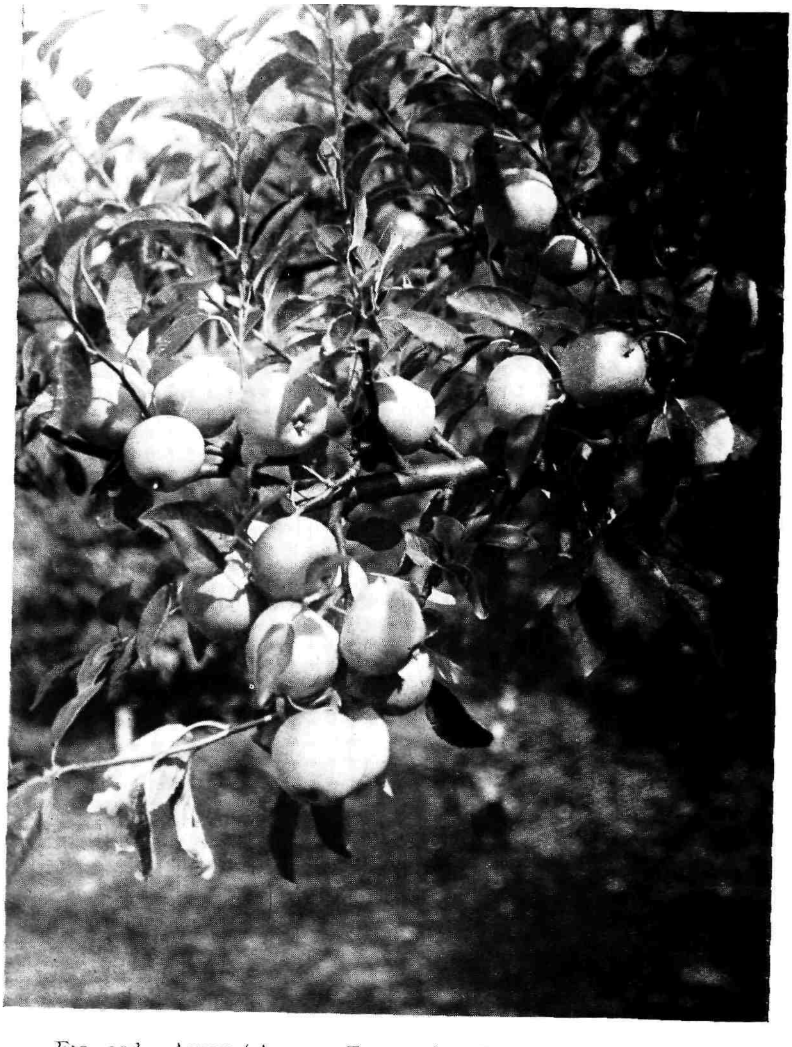

FIG. 19d.—APPLE 'ARTHUR TURNER' IN WISLEY FRUIT TRIALS.

[To face p. 121.

THE NATIONAL FRUIT TRIALS.

By Sir A. D. Hall, K.C.B., F.R.S.
Chairman of the Joint Committee.

The need for exact and disinterested trials of the comparative value of varieties is even more evident in the case of fruit trees and bushes than with the crops of the farm. A farmer may be tempted to buy a new wheat or barley at a comparatively high price, but one or two years' growth upon his own farm will inform him whether it is good or not. If not, his loss will have been little more than the extra price he paid for the seed in the first instance. But if a fruit-grower plants a new variety of Apple, it will be at least ten years before he can make up his mind about its value, and if then he concludes he must scrap it, he is about £100 an acre out of pocket. Small wonder, then, that the commercial fruit-grower is cautious about trying new varieties, especially as the market has also to be persuaded to get into the habit of buying anything novel. There is this further purpose behind exact fruit trials—to inform the fruit-growing community of any new introduction of outstanding merit, which otherwise might only get known by a slow process of personal opinions and communications. 'Cox's Orange Pippin' was raised about 1830, but only became generally known some 50 years later and has only experienced its great extention in the present century. Nor is it easy for any one individual to form a final judgment about a given variety of fruit. Most of them have marked individual responses to soil and climate and may be strongly affected by the stock on which they have been worked. Susceptibility to disease is a factor of importance and can only be estimated when a reasonable number of plants are grown over a period of years.

In spite of these difficulties of coming to a conclusion, perhaps indeed because of them, a very great number of new varieties of the standard fruits are introduced every year. The raiser naturally is inclined to see excellencies in his product and to minimize defects for which he would condemn one of its older rivals; he has something to sell, and it is possible to produce a shapely dish of fruit at the shows from many a variety that is a failure commercially.

It was with these considerations in mind that the National Fruit Trials were started in 1922, after discussions between the Ministry of Agriculture and the Royal Horticultural Society. The scheme is administered by a Joint Committee; the conduct of the central trials is entrusted to the Royal Horticultural Society at Wisley, who bear the expense with the aid of a grant from the Ministry and a contribution from the trade collected by the National Farmers' Union. In addition to the exhaustive tests at Wisley, the varieties selected there are passed on to sub-stations, ten in number, situated in various parts of the

country, which repeat the trials. The cost of these sub-stations is met by the Local Authority responsible for the demonstration centre, two-thirds being repaid by the Ministry.

The necessary preliminary to all trials is to make sure of the identity of the plant under examination. Particularly among fruit, synonyms abound; some are deliberate falsifications, others the result of chance and time. An Apple tree in an old garden may long have lost its label, but it may obtain a local reputation and eventually be propagated and distributed by a nurseryman who is unaware of its origin. Considerable difficulty has been experienced in the Wisley trials over varieties offered for trial as new seedlings which when grown cannot be distinguished in any feature from some well-recognized variety. Under a strict comparison the new introduction may crop a little more freely or grow with greater vigour, but there are no features to mark one from the other. One may suspect that the new stock is not a seedling but merely a clone worked up from a good specimen of the old variety, but the only evidence of origin is the word of the introducer. The general experience of plant breeders does not favour the idea that even selfed seedlings of an old cultivated variety will reproduce the parent exactly, at any rate the odds are heavy against such an occurrence. It is more likely to occur among simple diploids like Raspberries, Currants and Gooseberries, but the chance is exceedingly remote amongst hexaploid Plums, the octoploid Strawberries, and the complex polyploid Apples and Pears.

In order then to clear up these questions of synonomy the Royal Horticultural Society maintains at Wisley a standard collection of varieties, the most complete in the country. The approximate numbers now run to:

Apples	600 varieties
Pears	140 ,,
Plums	100 ,,
Cherries	20 ,,
Black Currants	70 ,,
Red and White Currants	40 ,,
Gooseberries	113 ,,
Raspberries	90 ,,
Strawberries	60 ,,

At present the National Trials at Wisley embrace Apples, Pears, Plums, Cherries, Raspberries and Blackberries, Red and Black Currants, Gooseberries and Strawberries and Nuts. In the first instance varieties for trial are recommended by the Fruit and Vegetable Committee of the Royal Horticultural Society, or by members of the Committee, and the initial material—plants, cuttings and scions—is obtained from the introducer of the variety. Each variety is then propagated at Wisley so as to obtain standardized plants, and in each trial some of the well-known varieties of the same fruit are planted alongside for comparison. In several cases with bush fruit it has been necessary to

rogue the original stocks as received and to eliminate individuals showing reversion or mosaic. After observation in this preliminary trial varieties are selected and propagated afresh for the trial proper in the following numbers :

Currants, Gooseberries, Raspberries, Blackberries and *Nuts:* 20 plants.
Apples: 20 half-standards on Malling No. XII, 10 each as bushes on Doucin and Broad-leaved Paradise stocks.
Pears: 20 half-standards on a selected Pear stock, 20 as bushes on Angiers Quince.
Plums: 20 half-standards on various stocks, some varieties on their own roots.
Cherries: 10 standards on selected stocks (at Borden sub-station only), 5 only at Wisley as bushes.

When the Wisley trials have shown that a variety is definitely good and of promise for commercial planting, it is approved by the Committee for inclusion in trials at the sub-stations. It is realized that the Wisley site represents a special type of soil and climate. The soil is a thin blowing sand that hitherto has never been regarded as fit for cultivation under any crop. Indeed its capacity to carry fruit successfully is dependent upon liberal manuring, especially with potash fertilizers, and the presence of subsoil water at a few feet below the surface, since the experimental area borders the river Wey. The climate is that of the lower Thames valley with a low rainfall. Spring frosts may be severe, so much so that in 1933 the Apple and Plum blossom was almost wholly destroyed. None the less the growth and cropping of all kinds of fruit, bush or top, has been exceptionally good, and there is little indication that the comparative results at Wisley may be seriously contradicted elsewhere. One specific feature that has emerged is that the very dwarfing stocks like Malling No. IX make too little growth to be satisfactory even for garden cultivation.

However there are many varieties which exhibit a definite response to local variations in soil and climate, and the object of the sub-stations is to obtain a more general picture of the behaviour of any new variety as well as to demonstrate locally the value of one that has given a good result at Wisley. The trees or bushes required by the sub-stations are all raised at Wisley, so as to ensure that the material is all true to name and comparable as regards stocks.

In the conduct of the trials at Wisley careful observations are made of the time of blossoming in relation to the weather conditions, the resistance to frost, the incidence of disease and the tolerance of sulphur and other spray compounds. The crops of soft fruit are weighed and the top fruit estimated each year ; consideration is then given to such commercial features as colour, uniformity of size, firmness of flesh for transport, and time of ripening in relation to other varieties. While certain standard varieties of each fruit are included in the trials so as to afford a definite basis for comparison, it has not been practicable to

arrange the plots so as to give results suitable for statistical analysis. This is chiefly due to the fact that new varieties, of Black Currants for example, are added from year to year, so that excessive space would be required if these additions had to be accompanied by a fresh plantation of the standard varieties for comparison. Again, so many of the factors upon which the variety has to be judged, such as disease resistance, quality, and firmness of flesh, cannot be assessed numerically. At some later stage, when the leading varieties have been picked out, it may be desirable to introduce a stricter technique of comparison, but at present the trials are less concerned with fine differences than with those which are well outside the limits of the experimental errors attaching to single plots when repeated over a series of years.

The trials have now been in progress for 12 seasons, long enough to have reached some conclusions with bush fruit like the Raspberries and Black Currants that were first put into the trials. Apples and Plums, however, considering the delay that must elapse in propagating the actual plants that are to be put out in the trials, are only just beginning to crop freely, even with those varieties selected at first, and several more years must elapse before their true character on the different stocks will be demonstrated. Some varieties come into bearing more quickly than others, and these differences persist even upon the dwarfing stocks. This adds another obstacle to the statistical discussion of cropping data ; the final judgment can be little more than a considered opinion of the Committee on the suitability of the variety for commercial planting after taking into account all the factors mentioned above.

The results as far as available will be found in the JOURNAL of the Society for September 1932 and February 1934, and it is to these reports that readers must be referred for the many particulars that are recorded.

The trials are naturally most exhaustive as regards some of the bush fruits which have had time to come to full maturity and to demonstrate the relative lasting power of the different varieties.

In the trials of Black Currants four standard varieties were included not only at Wisley but at all the sub-stations. These were 'Boskoop Giant,' 'Baldwin,' 'Seabrook's Black' and 'Goliath.' These are representative of the main types into which Black Currants can be divided, and in general it can be said that at every station one or other of these four is about the leading variety, though they exhibit preferences for particular soils and situations. For example, at Wisley over 7 years 'Goliath' was the most consistent cropper and gave an average of 4·9 lb. a bush, while 'Baldwin' only yielded 1·7 lb. At Merton, 'Boskoop' was the best, a five years' average being 6·9 lb. against 6·3 lb. from 'Goliath' and 3·9 from 'Baldwin.' But at Osgodby 'Baldwin' leads with an average of 6·3 lb. against 5·3 for 'Goliath.' Taking all stations together, 'Goliath' is the most consistent cropper. Other considerations have to be taken into account ; 'Boskoop' is the earliest and 'Baldwin' the latest of these

varieties; 'Goliath' and 'Boskoop' are sweet and tender skinned, 'Seabrook's Black' and 'Baldwin' acid and tough skinned.

Of the many newer varieties which have been under trial few have given real promise of replacing the standard varieties mentioned above. 'Daniel's September' may be useful where an extra late crop is desired; 'Westwick C,' 'Matchless' and 'Supreme' are of considerable promise. But the result of the trials has chiefly been to discount the claims that have been made for many new introductions, and it may almost be concluded that in the standard varieties, provided one suited to the soil is picked out, the limit of commercial production has nearly been reached, so that the new seedlings produced by intercrossing between these standard sorts are not likely to show much advance.

Raspberries have also been subjected to long-continued trial, and a number of varieties have been thoroughly tested and eliminated. Many synonyms have been identified; on the other hand, it is well known that many stocks of standard varieties in commerce are not true to name. Three varieties have consistently stood out in the trials—'Lloyd George,' 'Pyne's Royal' and 'Red Cross,' though it is increasingly difficult to obtain stocks of 'Lloyd George' free from mosaic. 'Matchless' is promising, 'Lynn's Superb' is recommended for gardens, but the fruit does not travel well, and 'Norfolk Giant' is an excellent late variety for canning or jam. The trials of Blackberries and the hybrid Rubi have not yet advanced far enough for comparative reports, though several synonyms have already been detected. The "berries" constitute a very interesting group of fruits, many of which show the exceptional vigour that may be associated with their polyploid constitution. Amongst the native Blackberries both diploid and tetraploid species can be found, together with triploids resulting from their intercrossing. Some of the tetraploids have been picked out for their cropping power; among these are the 'Himalayan Giant' and 'John Innes,' the former a chance wilding, the latter a cultivated seedling of interesting parentage. The well-known Loganberry is a hexaploid which may be presumed to have arisen from the American Dewberry possibly by hybridization with the Raspberry. In other cases hybridism with the Raspberry is in evidence, and varieties with a triploid, pentaploid and even heptaploid constitution have been introduced. Generally, however, those individuals with an uneven number of sets of chromosomes are relatively infertile. In this section of domestic fruits the plant breeder is busy, and without doubt great improvements on existing varieties may be expected.

Among Red Currants, 'Laxton's No. 1' has stood out consistently, both as regards its cropping and its capacity for making sturdy bushes. Only trials such as these could have made known so definitely and so widely the excellence of this variety; under the old conditions years would have elapsed before its merits could be generally recognized.

The trials of Plums are naturally not so far advanced as those of the soft fruits, and all that can at present be said on the results obtained at Wisley is that three varieties have been picked out for more extended

trial at the sub-stations. These are 'Early Laxton,' a variety ripening a week or more earlier than 'Rivers' Early Prolific,' 'Laxton's Gage' and 'Cambridge Gage.' The last variety is almost indistinguishable from the old Greengage, but appears to be a surer cropper and to some extent self-compatible—that is to say, capable of fertilization by its own pollen. Plums vary, some, like 'Victoria,' being self-fertile, others wholly self-sterile, like several of the Gages and 'Pond's Seedling.' While pollination can be secured by judicious interplanting, so dependent are Plums on adequate fertilization that self-fertile varieties only can be regarded as suitable for commercial work, and with few exceptions no new self-sterile variety should be distributed.

With Apples again the trials are still in a tentative stage, though certain varieties on their performance at Wisley have been picked out for distribution to the sub-stations. The results are discussed in detail in Mr. Rawes' paper.

These are but a brief selection of some of the more definite results that have been obtained by the National Trials at Wisley and the sub-stations. In the reports many additional details will be found; for example, data on the relative dates of flowering and of the duration of the flowering period of each variety, of susceptibility to scab and to frost injury. Again, not only opinions on the quality of the fruit and its texture for travelling are recorded, but the fruit is sent to the Fruit Preservation Research Station at Chipping Camden for a test of its behaviour under canning.

Thus the National Trials, though still in the early stages of their development, are already providing the commercial fruit-grower with a body of exact information which hitherto was only obtainable from individuals whose experience was necessarily limited both by their conditions of soil and climate and by the extent to which they could afford to experiment with new varieties. Not only the printed reports available but the trials are open to the inspection of growers, who can form a very sound opinion of the merits of the variety when they see it in crop as a row of bushes or a block of trees. No such systematic testing can be seen elsewhere and the trials may be regarded as indispensable to the success of the rapidly increasing fruit industry in England.

NEW VARIETIES OF APPLES AND PEARS.

By A. N. Rawes.

Since the commencement of the Commercial Fruit Trials in 1922 we have planted in the orchards at Wisley more than 100 new varieties of Apples and Pears—all of which satisfied the Selection Committee that their fruits possessed some characters of commercial merit—so you will understand we are not short of material. This number, of course, represents a very small proportion of the hundreds of unnamed seedlings and new varieties which have been before the Society's Fruit

Committee for preliminary judgment, but which were not considered suitable for inclusion in the trials.

Certain of the varieties planted in the trials have, after a suitable period of testing, been discarded as not up to standard; just what their faults are need not concern us now. The trees of many more are not yet sufficiently mature to enable considered judgment of their qualities to be formed. As yet, only seven of the Apples have shown such promise at Wisley as to merit planting at the sub-stations for extended trial, and one or two of these will, I think, prove superior to certain of the older varieties.

A convenient way to bring these and some others to your notice will be to run through the list of those which I regard as the more promising—taking them, not in any particular order of merit, but roughly in their order of ripening. There will be no time to go into detailed account of the characters and qualities of all of them, but almost all can be seen in the Exhibition Hall; nor will there be time to give particulars of their parentage, the year of introduction, the name of the raisers, and so on. Some of these particulars you will find at the end of this paper. It will be understood that the opinions expressed here are my own, and not necessarily those of the Fruit Trial Judging Committee.

I take it as generally agreed that the range of existing dessert Apples of proved commercial merit, is much more restricted than with the culinary varieties, and that the need for new varieties of good dessert quality for commercial planting is plainly evident.

There is, of course, no real shortage of dessert Apples of excellent edible quality—but unfortunately the majority are sadly lacking in one or more of the characters essential to the "make up" of a variety for market growing. We have yet to find the really good early-ripening dessert Apple. There are several of this type undergoing trial, and among the earliest, ripening in mid-July, is 'Laxton's Early Crimson'—a small, deep red apple, of no particular flavour or quality, perhaps, though still to my mind an improvement upon the imported Apples which come on to the markets in July. Our young trees of 'Early Crimson' have cropped heavily, but, to its discredit, the fruit is rather too small and—as with most early varieties—a great proportion of the crop is apt to drop prematurely.

Another early Apple—ready about the time of 'Beauty of Bath'—is 'Melba,' a variety raised by the late Mr. MACOUN at Ottawa. We have received twenty seedling Apples from this source—mostly seedlings from 'McIntosh Red'—and while 'Melba' is probably the most promising of all, it has, I think, serious faults. The trees crop remarkably freely and the fruit is a good medium size, the flesh is soft, very juicy and sweet. The colour is not always attractive; often it is very pale with a faint flush or striping, and the fruit is so very soft and easily bruised, that while 'Melba' may possibly find a place as a variety for a special trade—that is, for local sale and immediate consumption—it is hardly the type of early apple we are looking for.

Ripening a few days after 'Beauty of Bath' is 'Maidstone Favourite.' This closely resembles the older variety in all characters, except that it is a week or two later in ripening. There is no improvement in quality I am afraid, but the trees of 'Maidstone Favourite' at Wisley have consistently carried heavier crops than those of 'Beauty of Bath,' and to help fill the gap between 'Beauty of Bath' and 'Worcester Pearmain,' some may find this a useful one to plant.

About the same season—during August—one of the seedlings raised by Mr. Crane at Merton, known as 'Seedling 413,' is ripe. This is a medium sized, conical and fairly firm Apple, notable for its brilliant colour. The edible quality of the fruit and cropping capacity of mature trees remain to be proved, but judging by the appearance of the fruit and the behaviour of the young trees at Wisley, it may well find such favour as to take the place of the immature 'Worcester Pearmains' which find their way into the market long before they are really fit for human consumption. We come then to three of Messrs. LAXTON's new varieties, 'Advance,' 'Epicure,' and 'Exquisite.' 'Laxton's Advance' is an early Apple of first-rate quality without doubt; the fruit is of medium size, heavily coloured crimson, conical in shape and the flesh is much crisper and firmer than most early apples. It requires further testing, but I have good reason to think that it will, in a few years, rank high in the list of August dessert Apples for commercial planting.

'Laxton's Epicure' ripens early in September, and is a medium-sized, round Apple of good quality. The Apples are usually well coloured, striped and flushed with red—not quite so bright and attractive as some others, perhaps, and it is not improved as a market variety by its very long stalk, but nevertheless it is a promising variety. This is closely followed by 'Laxton's Exquisite'—a slightly taller apple, not quite so evenly shaped as 'Epicure,' but more richly flavoured. As yet it is difficult to say which of the two will prove better for the grower and market, but at present I am inclined to give slight preference to 'Exquisite.'

So much for the pre-'Worcester' season. There are several new varieties which ripen in late September and early October. 'Ellison's Orange' is already well known, and its popularity will, I think, increase. Some people dislike the curious flavour—described as a taint of aniseed, but this, apparently, is not pronounced in the fruit grown in all districts. There are four bud-sports of 'James Grieve'—alleged and real—in the trials, but our tests of these, as yet incomplete, have so far failed to produce fruit which I regard as any improvement upon the original variety.

Ripening about this time and keeping sound and firm for two or three months is 'Millicent Barnes.' The trees in the trial grounds have attracted the attention of many visiting growers; crops have been very heavy and the Apples are of good medium size, conical, very firm, and brightly striped with red. The variety appears to have most of the characters desirable in a commercial variety—but it does, I fear,

lack that high quality and flavour we associate with other well-known dessert Apples " in season."

We come then to the variety ' Lord Lambourne.' This variety is growing at the sub-stations, and results from the trees growing under these widely different conditions of soil and locality must be obtained before official recommendation is earned. ' Lord Lambourne ' is already being widely planted, of course, and I feel sure many more acres will be devoted to it in the near future. It makes a good tree and is one of the most reliable croppers of all. The fruit is attractively coloured—almost entirely covered with a bright red flush and stripes—and it has the size and form that is wanted, evenly rounded or only slightly flattened and firm enough to travel well, and although its season is a comparatively short one, and the quality and flavour may not bear comparison with that of ' Cox's Orange Pippin,' it is, I think, satisfactory. ' Lord Lambourne ' will clash with the early—often much *too* early—market consignments of ' Allington Pippin,' and with the last of the ' Ellison's Orange,' but it could be cleared before the ripe ' Cox's Orange Pippin ' come in, and is, I think, a variety deserving recommendation.

Ripening a little later, about the time of ' Cox's Orange Pippin,' is the new variety ' Woolbrook Pippin.' Our young trees of this are carrying a good crop this season ; the fruit is of a good medium size, firm and of fairly good flavour, and the variety has many characteristics to recommend it. But a new dessert variety to find a place at this season, about November and December, must be outstandingly good, and I doubt if the fruits of ' Woolbrook Pippin ' have quite the attractive colouring and "finish," or the high quality, that is required.

Another dessert Apple to come in just before Christmas is ' George Carpenter.' This is a highly coloured Apple of ' Blenheim Orange ' type—but without the keeping qualities of ' Blenheim.' The fruit is very brightly coloured of good size and form, and the edible quality—for a few weeks, at any rate—is good. But its season is too short, and like a ' Blenheim,' it is such a shy cropper when trees are young, that its place is in the private garden, rather than the commercial plantation.

Next comes ' Laxton's Superb.' ' Superb ' is well known and extensively planted all over the country, of course—and its popularity will increase. In growth and cropping, in the form and travelling capacity of the fruit, in quality and flavour, it is entirely satisfactory when grown under most conditions. Two complaints one hears about ' Superb '—one is that the fruits sometimes are rather too large and lack that bright and attractive colouring which is, apparently, so desirable. The fruit from young, vigorous trees may be a little oversize and dull, but I find these failings are corrected as the trees reach mature age, though the colouring, as in Apples generally, is a quality dependent a good deal upon locality and soil conditions. In districts where it does colour well ' Laxton's Superb ' is a profitable Apple to

grow, to follow 'Cox's Orange Pippin,' its season extending from November to March.

As yet there are few promising new dessert apples to follow 'Laxton's Superb.' I had hopes, at one time, that 'St. Cecilia' might prove to be the late-keeping dessert Apple of high quality that is so badly needed—but I am rather disappointed in its performance during the last few years. 'St. Cecilia' is a good dessert Apple—the fruits keep sound until March, or even later, and the quality and flavour improve with keeping; but apart from the fact that the trees will not stand sulphur in any form, I am afraid much of the crop is likely to come rather too small to suit market requirements, and as with many other new varieties I could mention, its proper place, I think, is in the garden. And there I must leave the dessert Apples and pass to the culinary varieties.

Among early varieties, two of outstanding promise are 'Sowman's Seedling' and 'Arthur Turner.' The fruit of 'Sowman's Seedling' is evenly round or very slightly flattened and deep green in colour, and it will compete with the very popular 'Grenadier' and 'Early Victoria.' Our trees of 'Sowman's Seedling' crop remarkably well; it is a good grower and does, I think, provide a more regular and evenly-shaped sample than the older varieties. The other early cooking apple is 'Arthur Turner,' and this scores over most others in the large size the fruits attain as early as the middle of July. The normal season of 'Arthur Turner,' of course, is October and into November, when the fruit is very large and partly coloured with a brownish flush. But its value as a commercial variety will lie in its suitability for selling early—in July or August when the fruit is deep green in colour and larger and heavier than any of the Codlins, or such as 'Grenadier' and 'Ecklinville Seedling.' The trees are of vigorous, upright habit; those in the trial block at Wisley have cropped remarkably freely; and a variety such as this, which can be marketed from July onwards, or if market conditions demand, can be held back until September or October, seems to me to be a very useful acquisition. Incidentally, the amateur may be interested to know that the blossoms of 'Arthur Turner' are unusually large and brightly coloured a deep rose red, making a most decorative tree for the garden.

There are several new mid-season culinary varieties, and one that promises well is 'Alderman,' a compact grower and a very heavy and regular cropper, bearing large, deep green Apples which cook splendidly —but, clashing as it does with the season of 'Lord Derby' and the early 'Bramley's Seedling,' it is unlikely, perhaps, that 'Alderman,' or any other new variety we have as yet tested, will offer serious competition.

Two other good cooking Apples calling for special mention are 'Monarch' and 'Crawley Beauty.' 'Monarch,' I think, offers serious challenge to the old 'Newton Wonder' of much the same season—in fact I think it might well displace 'Newton Wonder' altogether. The trees of 'Monarch' under trial have grown well and cropped regularly and

very heavily, and, to anticipate any discussion to follow, I may say that I have no evidence that the variety is any more or less susceptible to canker than are most others. ' Monarch ' is already widely planted in many districts, and if, as I am told, it has not always earned complete approval, I think it will continue to hold a high place in the list of late cooking Apples for commercial planting.

The other variety is ' Crawley Beauty.' This is another that should become increasingly popular, chiefly because it is such a reliable and regular cropper. It is the latest of all Apples in the trials to come into blossom. The fruits are brightly striped—which is not always an advantage in a cooking Apple—they are firm and evenly-shaped, and if ' Crawley Beauty ' has a fault it is that the fruits are apt to come rather on the small side for a late cooking Apple.

It is interesting to note here that we have two " bud sports " of ' Newton Wonder '—both resembling the original in every way except that the fruits are remarkably highly coloured—they are a deep red all over. I doubt if these will meet with the general approval of the grower or the salesman.

Now a word about the several dual-purpose Apples under trial. I do not myself favour this type of Apple ; but that is perhaps not a general view. One variety called ' Woolbrook Russet ' bears fruit resembling ' Bramley's Seedling ' in shape and form—not a recommendation in itself. The Apples are deep green, covered on one side with a brownish flush, and they are very solid and heavy. The variety requires further testing as to cropping capacity, disease resistance, and so on, but from what I have seen, it seems distinctly promising ; the fruits keep sound until March and April, they cook splendidly and the smaller fruits, late in the season, make quite fair dessert. ' Herring's Pippin ' is another of this class—bearing very highly coloured but rather soft fruits in season in November, and I could add considerably to this list, with ' Geo. Neal ' and ' A. W. Barnes ' to mention only two—but we must pass to the Pears.

Here there is a very different tale to tell. We are very short indeed of good new Pears. There are, in fact, only six new varieties undergoing trial and of these only two have as yet reached good bearing age. One is ' Laxton's Superb '—not altogether new, but as yet not so widely known and planted as its qualities deserve. It is described as an early ' Williams' Bon Chrétien '—ripening in late August—and the quality and flavour is good. The other is ' Beurré Bedford,' a long, brown-skinned Pear, in season in October. ' Beurré Bedford ' has qualities to recommend it ; but generally, the position of older varieties is still, I think, unchallenged.

In this brief catalogue of new varieties we have under trial, I have perforce omitted mention of several that are already showing considerable promise. You may have anticipated more definite recommendations ; that such and such a new variety is vastly superior to another and so on—but until our trials of the more recent introductions, both at Wisley and at the sub-stations have progressed, and

we have trees of more mature age to observe, further comment would be premature.

As I have said, we have in the trials many promising varieties coming along, among which—so far as Apples are concerned—we may find the 'early Cox,' or perhaps the 'late Worcester'—with, I hope, improved quality—which I am so often informed is what the commercial grower is so anxious to have.

NEW VARIETIES OF APPLES AND PEARS MENTIONED IN PAPER.

Variety.	Raiser and Introducer.	Parentage.	Season.	Award (for Garden Planting)
DESSERT APPLES:				
'Advance'	Raised 1908, and introduced 1929 by Messrs. Laxton, Bedford	'Cox's Orange Pippin' × 'Gladstone'	August	A.M. 1932
'Early Crimson'	Raised 1908, and introduced 1931 by Messrs. Laxton, Bedford	'Worcester Pearmain' × 'Gladstone'	July	—
'Ellison's Orange'	Raised by Rev. Ellison Bracebridge, and introduced by Messrs. Pennell, 1911	'Cox's Orange Pippin' × 'Calville Blanche'	September–October	A.M. 1911 F.C.C. 1917
'Epicure'	Raised and introduced by Messrs. Laxton, Bedford	'Wealthy' × 'Cox's Orange Pippin'	September	A.M. 1931
'Exquisite'	Raised and introduced by Messrs. Laxton, Bedford	'Cellini Pippin' × 'Cox's Orange Pippin'	September	A.M. 1926
'George Carpenter'	Raised by Mr. G. Carpenter, Byfleet, 1902; introduced by Messrs. Brinkman	'Blenheim Orange' × 'King of the Pippins'	December	—
* 'Laxton's Superb'	Raised 1897, and introduced 1922 by Messrs. Laxton, Bedford	'Wyken Pippin' × 'Cox's Orange Pippin'	December to March	A.M. 1919 F.C.C. 1921
* 'Lord Lambourne'	Raised 1907, and introduced 1923 by Messrs. Laxton, Bedford	'James Grieve' × 'Worcester Pearmain'	October–November	A.M. 1925
'Maidstone Favourite'	Raised and introduced by Messrs. Bunyard, of Maidstone	Seedling from 'Emperor Alexander'	August–September	A.M. 1913
'Melba'	Raised by Mr. Macoun, Ottawa	Seedling from 'McIntosh Red'	August	—
'Millicent Barnes'	Raised by Mr. N. F. Barnes, Chester	'Gascoyne's Scarlet' × 'Cox's Orange Pippin'	October–December	—
'Seedling 413'	Raised by Mr. M. B. Crane at John Innes Hort. Inst. 1915	'Antonowka' × 'Worcester Pearmain'	August	—
* 'St. Cecilia'	Raised 1900, and introduced in 1918 by Messrs. J. Basham, Bassaleg	Seedling from 'Cox's Orange Pippin'	January to March	A.M. 1918 F.C.C. 1919
'Woolbrook Pippin'	Raised 1903, and introduced later by Messrs. J. H. Stevens, Sidmouth	Seedling from 'Cox's Orange Pippin'	November–December	A.M. 1929
DUAL-PURPOSE APPLES:				
'A. W. Barnes'	Raised by Mr. N. F. Barnes, Chester, 1902	'Cox's Orange Pippin' × 'Gascoyne's Scarlet'	October December	—
'George Neal'	Raised by Mrs. Reeves, Sevenoaks, 1904; introduced by Messrs. R. Neal, Wandsworth, 1923	?	September–October	A.M. 1923

* Varieties selected after testing at Wisley for extended trial at sub-stations.

NEW VARIETIES OF APPLES AND PEARS MENTIONED IN PAPER—*continued.*

Variety.	Raiser and Introducer.	Parentage.	Season.	Award (for Garden Planting).
DUAL-PURPOSE APPLES—*cont.*:				
*'Herring's Pippin'.	Raised by Mr. H. Lincoln, and introduced by Messrs. Pearson, Lowdham, in 1917	?	November	A.M. 1920
'Woolbrook Russet'	Raised 1903, and introduced later by Messrs. Stevens, Sidmouth	'Bramley's Seedling' × 'King's Acre Pippin'	November to April	A.M. 1930
CULINARY APPLES:				
'Alderman' . .	?	?	October–November	—
*'Arthur Turner' .	Raised and introduced 1915 by Messrs. Chas. Turner, Slough	?	October–November	A.M. 1912
*'Crawley Beauty' .	Introduced by Messrs. Cheal, Crawley, 1906	?	January to April	A.M. 1912
*'Monarch' . .	Raised 1888, and introduced 1918 by Messrs. Seabrook, Chelmsford	'Peasgood's Nonsuch' × 'Wellington'	October to April	—
'Sowman's Seedling'	Raised 1914, and introduced 1927 by Mr. A. G. Sowman, Preston	'Grenadier' × 'Ecklinville Seedling'	August to October	—
PEARS:				
'Laxton's Superb' .	Raised 1901, and introduced 1913 by Messrs. Laxton, Bedford	'Beurré Superfin' × 'Williams' Bon Chrétien'	September	—
'Beurré Bedford' .	Raised 1902, and introduced 1921 by Messrs. Laxton, Bedford	'Marie Louise' × 'Durondeau'	October and November	—

* Varieties selected after testing at Wisley for extended trial at sub-stations.

DISCUSSION.

MR. PAGET NORBURY: Through the courtesy of the Secretary of the Royal Horticultural Society I was privileged to see the papers that you have had read to you, previous to the Conference. Yesterday afternoon I spent walking round the Show with the greatest interest, and my chief regret, and it is a very great regret, in fact it is a personal grievance, is that I feel I was born too soon when I think of the chances that the beginner has in these days compared with those that I had when I started, not knowing one apple from another, no one to help me, no research stations, and in complete ignorance of the whole industry. If one starts to-day one has some reliable knowledge obtainable from different sources. Sir DANIEL HALL's speech made me still further regret matters, and it seems to me if we are to follow his advice there would be a new duty devolving upon godfathers and godmothers when a child is baptized, because, if it is to take ten years to prove an apple and then you are only to obtain it in small quantities, there would be twenty years gone before you can get anything back. I do not believe in that policy at all. I have followed a certain practice

throughout my career. I may be one of those fools who rush in where angels fear to tread, but it is an inborn characteristic for a Britisher to gamble. I expect most of you in this room occasionally have a flutter either at cards, races, dogs, or on the Stock Exchange. Why not try a gamble on apple growing? I have been at it a very long time. I gambled first with 'James Grieve' thirty-two years ago. I have never regretted it. No apple has paid me better. I gambled on 'Lord Lambourne' and when I say I gambled, I do not mean in hundreds, I mean getting on for thousands. I never gambled with less than a hundred. Then I gambled with an apple perhaps unknown to you, 'Lord Rosebery.' I have gambled again with 'Superb' in thousands; and again with an apple which has been mentioned to you by Mr. RAWES this morning, 'Melba.' I may be wrong, but if I am wrong in this, in the majority of cases in the past I have been right. If one is going to wait all one's life to see which way the cat will jump, one will never get anywhere. You will never have any success unless you take some risks and have a shot at some of these new apples that we have been told about to-day. I have not done it on as large a scale as I should like, but I will mention the most important. I have not got 'Exquisite,' which is probably a winner; I have 'Fortune,' which has not been mentioned, by the way, although it will be mentioned in the future; I also have 'Epicure.' If one out of the three I have planted is a winner I do not mind. I also had a large number, something like 600, of an apple I have grown myself called 'Rosamond,' a red 'James Grieve.' The heads of all these are off as not coming up to expectation and are now grafted with 'Superb' and 'Lord Lambourne,' and in a few years one may expect a fair crop and a return for the cost and loss of time. We have been hampered for years by a lot of bad dessert apples and, although I think 'Melba' should be a winner, there is no other early apple mentioned to-day that is worth consideration, perhaps with the exception of 'Miller's Seedling.' There is the opportunity, there is a demand, and I am quite certain that as long as an apple is of good edible quality and follows up in proper sequence you will have a demand for every apple you can grow in this country.

We ought to be deeply grateful to the people who have taken the initiative in producing these new varieties, and I include the new variety apples which were grown by the late CHARLES ROSS. He stood alone some twenty-five to thirty years ago in attempting to produce superior apples. I do not say he produced anything outstanding, but he was a real tryer and was a pioneer in the work of new varieties of apples. I think at any rate the apple named after him will continue the memory of CHARLES ROSS.

Again we have to thank Mr. LAXTON and the Laxton family for all they have done. I feel perfectly certain they must have lost a very considerable amount of money in breeding new varieties, but they do not care as long as in the end they produce a good article. I do not know whether I am right in saying they have lost money, but I think

Mr. LAXTON himself was my informant, so it will not be very far off the mark.

Again we have an outstanding man in Mr. M. B. CRANE of the John Innes College, Merton, and we believe and hope that their work will be duly rewarded, if not at the present time, at any rate in years to come.

There were one or two other points that occurred to me as I listened to these papers. I think the question of colour is rather overrated. After all, what are the two best imported apples to-day—both green apples, 'Newtown Pippin' and 'Granny Smith.' Where is the colour there? Yet there is an unlimited place for these apples when they come on the market. I wonder what Mr. RAWES' opinion would be if 'Worcester Pearmain' had been a new apple to-day. Can you imagine his report on that apple? Although I come from Worcestershire, I roundly condemn 'Worcester Pearmain,' and the sooner it is off the market and something better is placed on, the better it will be for us growers, although it is possibly at the present time one of the most profitable apples being grown.

THE FRUIT THE PUBLIC WANTS.

By H. L. Taylor.

A few weeks ago I was inspecting an Apple orchard of one of o largest Fruit Growers. He is a man of over forty years' experien(and is ever on the lookout for better methods of cultivation. Just week before a friend of his had been going over the same orchar(accompanied by the bailiff. Now this friend was an experience(grower but one of those who very much like to air their own opinions. To every problem he had a solution ; " I do this " and " I do that " he said. Some time after the tour of inspection was over the fruit grower turned to his bailiff and said, " Well, George, what do you think about it ? " After thinking for a minute and scratching his old head he made this wise reply, " Them that's lucky thinks they knows." I think this was a very sensible answer as no one man can answer all the problems of fruit growing and distribution. At a Conference such as this the scientist, the grower, and the retail distributor can each contribute their quota to the general pool. I have the honour as a retailer to read a paper the purpose of which is to try to answer this problem, " What fruit does the public want ? " In so far as the grower endeavours to supply this need, so will the industry prosper.

Apples.

There is no denying the fact that the public consumption of pples is enormous. English growers only supply about one-fifth of is demand. To give you some idea of the quantity consumed in s country, here are the figures of the Apples imported from all rces for the past three years.

1931.	1932.	1933.
,000,000 bushels.	24,000,000 bushels.	21,000,000 bushels.

t is quite evident from these figures that the British public wants

ow what do the public really want ? Here is a letter published Daily Mail of December 7, 1933 :

ir,—Can any reader tell me what has become of our good old apples ?

r three years now, in London, I have persistently tried to e good English Blenheims, or Cox's Orange Pippins, but though ut no limit as to price not once have I received the right fruit. apples delivered have been a cross between a potato and a ithout any juice, though stated on the bill to be English."

ly I saw this letter I sent a small package of the finest Kentish x's Orange Pippin ' as a sample of what could be supplied,

followed up by a letter offering to supply any quantity as sample sent. I hope the gentleman enjoyed them, but I received no reply. Evidently the retailer who supplied this gentleman was at fault. This is one point on which I shall touch later.

Dealing with dessert Apples first: What are the actual qualities that are required? I would place an Apple that is juicy and of good flavour in the first position. In my opinion there are three varieties which answer to this description: 'Miller's Seedling,' 'James Grieve' and 'Cox's Orange Pippin.' Every grower will agree that from a price point of view they come out at the top of the tree. No matter how good an Apple looks if it has no flavour and is not juicy it will eventually lose favour with the public.

Secondly, I place size. From a dessert point of view this is most important. The best size is undoubtedly $2\frac{1}{4}$–$2\frac{1}{2}$ or even up to $2\frac{3}{4}$ inches. In a few cases 2-inch size will sell well, such as 'Miller's Seedling,' 'Beauty of Bath' and 'Cox's Orange Pippin.' Our Dominion growers are alive to this, judging by an extract from the Evening Standard of June 1934.

"If the average London housewife does not get five apples to the pound she thinks she is getting under-weight.

"This trait in her character has been discovered by importers, and steps are being taken in Australia to see that apples sent into this country conform to certain regulation sizes.

"An official of Australia House stated to-day that Australian apples entering England are now restricted to forty kinds, and none must be more than three inches in diameter.

"'Big apples are unpopular,' he said.

"The housewife who has a large family to cater for finds them too expensive."

Thirdly, I think the public requires fruit in good condition and of good appearance. This depends entirely on how the grower sends his fruit to market. If Apples reach the market badly bruised, covered with scab and poorly packed, in what condition will they be by the time they reach the consumer's table. During the last fifteen to twenty years there has been a marked improvement in this direction and many growers are fully alive to the importance of condition and appearance. Unfortunately there are still some who think it does not matter how fruit reaches the market. To them we might apply the answer of the little girl who was sympathizing with her mother who had been unsuccessful in a cake competition. "Never mind, Mummy," she said, "you have got a very highly condemned." The day of the topped basket, I hope, is gone. Every grower should avail himself of the wonderful work of the Research Stations and also study the market by paying periodical visits to the market where he sends his fruit. He will then see how it arrives. I am sure it would be time well spent.

Fourthly, I place colour. You may well ask why this quality is so low down the list, because we are told a good coloured Apple sells itself. As I have said before if an Apple has colour but no flavour the

public will not eventually buy it. This is the reason why 'John Standish' is such a failure. I have seen this variety win prizes at our Kent Fruit Shows, owing to its wonderful colour and skin texture, but when displayed in the shop window it sells once only. The public does not buy it a second time. Yet colour is one of the qualities which growers strive for. It is true to say that there is no hard-and-fast rule about colour, as a good sample of 'Beauty of Bath' or 'Worcester Pearmain' is more in demand than poor coloured specimens.

Lastly, I mention price. The public wishes to buy Apples at a reasonable price. Good prices to the grower and cheap fruit in the shops are not easily reconciled. During the last twenty-five years, however, the public has been educated to pay a much higher price for fruit. I can remember the time when to sell Apples at 6*d*. per lb. was almost impossible, now it is quite a common figure. It is as well to remember that there is a very large public who can only buy Apples when cheap.

Now let us review the varieties that can generally be obtained on our markets to see how far they conform to the standards I have enumerated.

GLADSTONE.—This variety is not wanted now. To be perfect it should be eaten from the tree.

BEAUTY OF BATH.—A favourite with the public. On certain soils this grows to perfection. Must be marketed directly it is fit. Well-coloured and graded samples fetch a good price. Far too much rubbish, however, is placed on the market. I have seen large quantities this season marked up in quite good class shops at 1*d*. and 2*d*. per lb. This is no good to the grower or retailer.

LADY SUDELEY.—Quite a good Apple if sold immediately fit. Quite a large public likes the softness of this variety.

WORCESTER PEARMAIN.—Good samples sell well and still a favourite with a large public. Far too many reach the market in a very poor condition, immature and not well graded.

JAMES GRIEVE.—A splendid Apple, good flavour, good looking and a good seller.

AMERICAN MOTHER.—An unfortunate name. Good appearance and much liked by the public. There is room to grow many more of this.

ELLISON'S ORANGE. — Good appearance. The rather peculiar scented flavour of this variety, however, is not liked by some. Good samples sell well.

JOHN STANDISH.—Excellent appearance but no seller.

BLENHEIM ORANGE.—An old variety much liked, but it is very difficult to get good samples. Always sells.

CHARLES ROSS.—A great favourite, but too large.

COX'S ORANGE PIPPIN.—The finest Apple in the world. Always sells well, not nearly enough on the market. In my opinion growers should not strive so much for extra fancy prices, but to produce large quantities of this Apple to retail at a popular price.

KING OF THE PIPPINS.—Well liked. A good clean sample always sells.

LAXTON'S SUPERB.—I think a little disappointing. Too large at present ; whether it will last I have a doubt.

ALLINGTON PIPPIN.—Boomed as the new 'Cox.' Not liked by the public. Too hard and tart if eaten before December.

There are, no doubt, other varieties I have omitted. I think there is an opening for two varieties which will answer in description to the 'American Jonathan' and the 'Oregon Newtown Pippin.' Both these are in enormous demand ; the one because it is quite a good flavour, although soft, and the other for its crispness. Can any raiser supply this need for the home grower ?

Now a word about cooking Apples : speaking generally, the five points enumerated for dessert Apples apply to cooking varieties. Size plays a more important part however. Good sized samples of cookers sell better than small rubbish, as there is now a large demand for baking Apples. There is now one large firm who sell tens of thousands of apple dumplings weekly, and for these a large Apple is required. Colour is not an essential either, as most buyers like green Apples for cooking best.

The cooking Apple supreme is undoubtedly 'Bramley's Seedling.' This from every point of view is ideal. It cooks perfectly, grows a good size, keeps well and is a good colour. I am not in favour of the 'Red Bramley' or any highly coloured cooking Apple, as the public mostly prefer green culinary Apples. No imported Apple can approach the English-grown 'Bramley,' and the home grower need fear no competition from imported fruit. Some growers have said to me, the time is approaching when there will be too many 'Bramleys' on the market. With the introduction of gas storage, this variety can be placed on the market up to June at least. There is still a very large potential demand untouched. The retailer must be educated to supply the demand. One grower known to me persuaded a wholesaler in the North to try a few hundred bushels in April. At first the idea seemed to be that the public would not pay up to 6*d*. per lb. for cooking Apples. The wholesaler was amazed with the demand, and has already agreed to take many hundreds of bushels next season. Every retailer who tried them found the public would buy when they found the cooking quality was so excellent.

A few remarks about other culinary varieties may not be out of place.

GRENADIER and LORD SUFFIELD.—Quite good for early varieties.

BISMARCK.—Most difficult to sell, although I have been told they sell fairly well in the North.

LORD DERBY and WARNER'S KING.—Quite good for second early.

ANNIE ELIZABETH and LANE'S PRINCE ALBERT. — Both these varieties sell well.

NEWTON WONDER.—I do not think sells so well, largely due to the high colour under modern cultivation.

Bramley's Seedling.—The best in the world, always sells.

There are quite a number of other varieties, but commercially this will supply all that is required. I think most growers will admit that there are too many varieties grown.

Pears.

Of recent years there has been a large and increasing demand for good quality Pears. Whether, with our climate, it is possible to produce large quantities of first-class fruit is open to question. This may sound unfair to the home grower, but if growers will visit the shops and see the splendid Pears imported from Italy, California, Australia and South Africa, they will have to admit that very few home-grown Pears can compare in appearance with these.

The following points must be borne in mind when growing Pears for market:

First, the sample should be clean, free from scab, maggot and damage. Here is a problem for the grower.

Secondly, Pears should be graded evenly and each fruit paper wrapped. Some varieties mark very easily and lose appearance very rapidly. Too often English Pears are packed into baskets without any care.

Thirdly, flavour is most important. The flesh should be soft and melting. A few varieties have a peculiar granular flesh and these are not very popular. The most popular size averages about four to the pound. Large fruits will sell in certain quantities, but need very careful handling. There is a demand for small fruit to sell by the pound, but I always find that good clean selected fruit sells best if retailed in punnets.

Such varieties as 'Chalk' and 'Jargonelle' are in poor demand. The following varieties when well grown always command a ready market:

Beurré Bosc.
Beurré Diel.
Beurré Hardy.
Beurré Superfin.
Conference.
Doyenné du Comice.
Marguerite Marrillat.
Souvenir du Congrès.
Dr. Jules Guyot.
Williams' Bon Chrétien.

The first of all, of course, is 'Doyenné du Comice.' No Pear in cultivation can touch this variety for its rich melting flavour. It is indeed the Pear for the epicure.

One other variety I ought to mention—'Pitmaston Duchess.' Although not in the first-class as regards flavour, large well-grown specimens command a good price. It needs very careful handling, as when fully ripe it should be a clear yellow in colour without blemish.

As to-day is "Commercial Day" at the Conference, it will not, I hope, be thought inappropriate if I close this paper with a few suggestions. In the past Apple growing has been just Apple growing, but to-day it has been raised to the dignity of an industry. It behoves growers therefore to use every avenue whereby their product can reach the consumer. Each retail shop is a channel through which

the product of your industry will reach the public. Co-operation between producer and retailer therefore is essential. Think of it, there are over 10,000 shops in London alone selling fruit. Each ought to be advertising English Apples. Are they? Unfortunately we have to say "No." Look at the displays, hardly an Apple marked English, and those that are often belong to the "highly condemned" class. How can this be altered? Here are a few suggestions offered in no critical spirit, but with a sincere desire to help forward the English Apple industry.

First, take a leaf out of your competitor's book. Here is a copy of a notice I often find in a case of imported Apples.

"To the Purchaser of this Fruit:

"Every care has been taken in the growing, picking and packing of this fruit to ensure it reaching you in first-class condition. The sender will be pleased to hear from you as to the condition of the fruit on arrival, and will welcome any helpful suggestions or criticisms so that my fruit may reach you in perfect order. If the size of this fruit is not the most suitable for you please say which size you prefer."

It is quite evident that this grower wishes to co-operate with the retailer and is anxious to find out "The Fruit the Public Wants."

Then again, if I wish to make a display of Empire Apples I can obtain unlimited supplies of advertising matter. Well-printed posters for the window are sent free on request. By co-operation between several large growers, surely small window bills could be neatly printed with some such wording as:

KENTISH BRAMLEYS. The best Cooking Apple in the World.	BUY ENGLISH APPLES.

These could be placed in the top of each basket, or a supply sent to your Commission Agent for distribution.

A small card ticket for Apples and Pears printed with the name of the variety such as:

KENTISH COX'S ORANGE PIPPIN.

KENTISH DOYENNE DU COMICE.

would assist many retailers to make a better display. Such advertising would help to educate the public to ask for Kentish Apples.

Devonshire cream is known all over England. Why not *Kentish* Apples also? Being a Man of Kent you will pardon me mentioning "Kentish," but the idea applies equally well to any grower, and any district.

Then I am of the opinion that many retailers need educating to the fact that the public does want good English Apples and is willing to pay for them. Many do not know the names of the varieties sold. For instance, I have seen ' Lady Sudeley ' labelled ' James Grieve.'

A final word to the grower : Your task is to grow good clean fruit, pack it carefully and grade it well. If you do this, with the assistance of the retailer, the Apple growing industry can look forward to an increased output with the full assurance of the financial reward which it deserves.

THE FRUIT THE PUBLIC WANTS.

By H. V. TAYLOR, O.B.E., A.R.C.S., B.Sc., Commissioner of Horticulture, England.

THOSE who manufacture articles and those who produce food supplies are continually being advised to study the requirements of the public and to produce articles the public wants. Experience shows that it is the far-sighted manufacturers who adjust the designs and prices of their wares to public taste who usually achieve success. Evidence in support of this can be found in all branches of industry, from the manufacturer of artificial silk stockings to motor cars ; it can be found, too, in the fruit industry, for has not the Fruit Industry of the U.S.A. succeeded in capturing a large section of the world's market for their apples ?

Reflection, however, is necessary, for the mass production motor car, the artificial silk stockings and the American apples may be purchased not because they are most desired by the public but because of the price factor. This point must be considered. Some people, no doubt, are experts in silk stockings; others are knowledgeable of motor cars or apples, but on the whole the general public will lay no claim to use experts' judgment for any of these commodities, and so are unable to weigh up the finer qualities. Many people enjoy the artificially thinned and sweetened ciders better than the pure apple juice, and drink the cheaper port wines and champagnes with as much relish as they would the vintage brands. To a technical man with a trained palate, such peculiar taste seems strange, though its existence cannot be denied. The vintage differs from the crude only in its finer characters, and these can be distinguished only by an educated or trained palate. It is a sense that has to be developed.

Similarly, the merits of a high-class motor car, though recognized by an engineer, pass unnoticed by the layman. So with fruit: there is but a minority with developed palate and trained senses to recognize the finer points ; the vast majority desire only the general flavour of the strawberry, pear or apple, and would fail to recognize the delicate and special flavours present in the better kinds. Fortunately there are signs that more and more people join the " epicurean minority," so that the demand for selected kinds increases annually, but that is a subject on which evidence will be produced later in the paper.

These preliminary remarks are made to show that my paper makes no attempt to select "the most desirable kinds of fruits," but merely indicates the types that at the present time are being readily accepted by the public. In the time available only one fruit can be tackled, and the apple chooses itself.

Popular Apples.

National taste in apples was the subject of a paper read by the late Mr. W. T. MACOUN at the International Horticultural Congress in 1930, and the paper contained much information concerning the relative popularity of different varieties in various countries of the world. By means of questionnaires details were obtained as to kinds that were most frequently grown in the different countries of the world.

It is very difficult to decide exactly how far the apples that are produced in (or imported into) a country are the apples the public really wants, for ease of production and other factors have their influence in the selection of varieties. Often the purchasers have no choice but to accept what is offered. In the long run, however, supplies of any commodity are adjusted in accordance with demand, and it may be concluded that the apples the public uses are in some measure a reflection of what it wants, allowing for preferences in taste and the limitations of price.

The present supply of apples for Great Britain is drawn from orchards at home and from others in many countries of the world, and comprises an innumerable number of varieties. Eliminating, however, the supplies of the less important kinds, it is possible to compile a list of the major varieties which constitute the main apple supply of the country. The quantities of each of these is not known with absolute certainty and some measures of estimation has to be made. When this has been done, it appears that in recent years the order of importance would be 'Winesap' (13), 'Newtown Pippin' (12½), 'Jonathan' (9), 'Granny Smith' (5), 'Cleopatra' (4), 'Worcester Pearmain' (4), 'Gravenstein' (4), 'Spitzenberg' (3), 'Cox's Orange Pippin' (1). The numbers following the variety indicate the relative quantity used: thus for every one 'Cox's Orange Pippin' consumed there were 13 of 'Winesap' and 4 of 'Worcester Pearmain.' In considering this table it must be remembered that supplies of a variety come from more than one source. For instance, in addition to the home-grown 'Cox's Orange Pippin' supplies come from Canada, Australia, Tasmania and New Zealand, and consideration for all is given in the above computation.

Influences of Prices.

It is a fair argument that these figures in no way reflect the public taste, but indicate the varieties that were cheapest at that particular time, and the position of the 'Cox's Orange Pippin' at the bottom of the list could be used in support of this statement. This aspect has to be considered and weighed by the evidence available. There are persons in the large wholesale markets of this country whose business is to collect and send to the Ministry of Agriculture particulars of the

wholesale prices realized for apples of the principal varieties. Week by week these prices are recorded, and at the close of the season it is possible to secure an index figure for several of the leading kinds. Grouping together the varieties that sell at similar periods the prices per cwt. in 1933 were as follows:—'Beauty of Bath' 24*s*. 6*d*.; 'Worcester Pearmain' 25*s*.; 'Gravenstein' 25*s*. 6*d*. These figures suggest that the public pays much the same price for any variety of early apple and favours no special one. When the later varieties are considered a differentiation in price begins to manifest itself. The price for the 'Jonathan,' 'Winesap,' 'Delicious,' etc., was more or less the same—34*s*. per cwt.; that for the home-grown 'Allington' and 'Blenheim Orange,' 23*s*. to 24*s*., whereas the 'Cox's Orange Pippin' realized the high price of 72*s*. for English, 50*s*. 6*d*. for New Zealand and approximately 40*s*. for British Columbian, Tasmanian and Australian.

These differences in price suggest that the majority (with untrained palates) who pay more for the imported 'Jonathan' than the home-grown 'Blenheim' make their purchases as "apples" without reference or thought of the variety, and place fine appearance as the first consideration. With the discriminating public, *i.e.* the public with trained palates, flavour becomes the predominating factor. These people pay twice as much to get home-grown 'Cox's Orange Pippin' as they would to obtain 'Winesap,' and are so discriminating that apples of the same variety from different sources vary in price, which depends on flavour and not on colour. This public ranks the English-grown first, New Zealand second, and those from British Columbia, Tasmania and Australia equal third. It also discriminates between 'Newtown Pippin' (Oregon grown), price 40*s*. per cwt., and all other imported apples, 34*s*., including even the same variety from California, which fall in the same price group as the 'Winesaps,' etc.

Though the numbers of people with the discriminating taste are in the small minority, the fact that they exist and that the numbers are increasing is distinctly encouraging to the expert fruit grower. It suggests that flavour and quality will win through in the long run, and that the home growers in particular should constantly eliminate the poor fruits and plant up the good.

Facts concerning Common Varieties.

To return to the apple of the majority. What is there about these 'Winesaps,' 'Jonathans,' 'Worcester Pearmains,' that they are eaten so largely by the general public? They differ in shape, colour and appearance; all possess a mild apple flavour, they are moderately juicy; but most important of all they possess an acidity which varies within narrow limits. 'Winesap' 0·51; 'Jonathan' 0·46; 'Gravenstein' 0·59; 'Spitzenberg' 0·51; 'Newtown Pippin' 0·53. This seems to suggest that the degree of acidity preferred by the modern palate is approximately 0·5. Where the acidity increases as in 'Allington' to 0·67 or decreases as in 'Morgan Sweet' to 0·17, the varieties soon fail in their appeal. The 'Worcester

Pearmain' seems an exception, for in this variety the acidity is as low as 0·26. The 'Cox's Orange Pippin,' in addition to possessing a superb flavour, has an acidity within the favoured range, and that helps in making it superb.

The acidity of varieties such as 'Rome Beauty' 0·4, 'Newton Wonder' 0·60, places these varieties near the border-line, and explains why these "cooking varieties" are eaten in lean years.

Of cooking Apples the chief variety used is the 'Bramley's Seedling': perhaps fifteen Apples of Bramley to that of any other cooking variety. Here there is question of price, for the 'Bramley's Seedling' price figure would be 22*s.* as compared with other varieties at 15*s.* 6*d.* Here again acidity appears to be an important factor, for the 'Bramley's Seedling' and the 'Wellington,' which are rated supreme as cooking Apples, have an acidity of 1·0 and 0·98. The cooking Apples of lower rank, such as 'Lord Derby,' 'Lane's Prince Albert,' 'Baldwin,' etc., differ mainly in having a lower acidity in the juice.

An Orchard Study.

The same conclusion is reached from an orchard study. In the course of the Fruit Soil Survey * carried out in the Lower Greensand area of Kent by Messrs. W. H. BANE and G. H. GETHIN-JONES, 2,469 acres of Apple plantation were surveyed, and the relative proportions of the common varieties met with published. The predominance of 'Bramley's Seedling' was shown by the fact that 1,980 acres out of the 2,469 contained the 'Bramley's Seedling' to an appreciable extent, *i.e.* the 'Bramley's Seedling' was the chief variety over 80 per cent. of the area. 'Worcester Pearmain' was appreciable over only 30 per cent. of the area, and the 'Cox's Orange' appreciable over 6 per cent. These statistics of plantings indeed afford evidence that varieties now being planted are somewhat different from those planted twenty years ago. In the sample chosen in Kent, no young trees (*i.e.* below ten years of age) were found of 'Bismarck,' and only a few of 'Lane's Prince Albert' and 'Allington Pippin'; alternatively, while few trees of 'Cox's Orange Pippin' were seen in orchards of forty years ago, they were found in a high proportion of the young orchard. In fact, in the young orchards below ten years of age the varieties planted were a proportion of 'Bramley's Seedling' 59, 'Worcester Pearmain' 22, 'Newton Wonder' 21, and 'Cox's Orange Pippin' 20. Though not conclusive, these figures suggest that the modern planting programme contains some varieties that would be considered of good dessert flavour and cooking quality to the exclusion of really inferior kinds.

Thus, from the study of the market supply and orchard plantings the same conclusion is reached that the public taste for fruits is improving, for larger numbers of people regard dessert flavour and cooking quality as factors of importance than was formerly the case. This is all important for the home fruit-grower, for the climate of England is favourable to the full development of flavour and quality rather than to colour and appearance.

* Ministry of Agriculture Bulletin No. 80.

PEARS FROM A COMMERCIAL ASPECT.

By Thomas Neame.

It may interest the Conference to know that the Government computation of the ratio of imported to home-produced fruit in 1933 was:

Imported Apples 20; home-produced Apples 10.
Imported Pears 3¼; home-grown Pears 1.

There are, therefore, 10 times as many Apples grown at home as Pears, and 7¼ times as many Apples imported as Pears.

When I was asked to read this paper my first instinct was to say that there is no such thing as a "commercial" Pear, in view of the very small position it occupies in comparison with the production of Apples. But when I cast my mind around and thought of one or two considerable growers of Conference and Fertility Pears—for instance, the gentleman who is going to follow me—I thought perhaps there was something done in the way of commercial growing of Pears in this country.

The title of this paper is "Pears from a Commercial Aspect," and I therefore propose to treat it purely from that aspect, and shall base my remarks principally on my own methods of growing, gathering and marketing the crop.

Having decided to attempt Pear-growing on a commercial scale, the situation is the first consideration and, a site having been found, it is wise to consult the County Horticultural Adviser as to its suitability. The soil should be deep and well drained, the climate temperate, the plantations either naturally or artificially sheltered. Apart from the obvious effect of the wind in blowing mature fruit from the trees, most fruit trees appear to suffer from exposure to strong winds. Low-lying land and frost pockets should also be avoided. Water for spraying should be available.

The next questions are: choice of varieties and selection of a nurseryman. I should decide on a limited number of good dessert varieties, leaving for others the choicest but more fickle varieties, and I should avoid the stewing Pear. I grow 'Catillac,' but find it difficult to sell in any quantity. It is not apparently a question of price; my salesman has told me that reducing the price will not necessarily increase the sale; it is simply a fact that the housewife will not put coins in a gas-meter to stew Pears when she can buy excellent canned 'Bartletts' at a comparable price. I have a fair acreage of 'Doyenné du Comice,' which occasionally yields a very handsome profit, but over a period of years, 'Conference' is ahead of it in cash return per acre. The 'Conference' Pear has been very largely planted during recent years, but I should not hesitate to plant more, because it is a Pear that the

public has learnt to ask for by name, is a fairly regular cropper, apparently resistant to scab under ordinary spraying routine, and is what I can call an " honest " Pear. By this I mean one that softens first at the stalk-end as an indication of maturity and rarely breaks down unexpectedly like the 'Williams' Bon Chrétien,' 'Fertility,' and others. But the two last named are worth growing, the last because its free cropping enables it to be sold at a modest price and yet pay its way, but it must be rigorously thinned, and then thinned again. 'Williams' Bon Chrétien' is a Pear that the market asks for, and now that we can attain a reasonable control of scab, I have thought it worth planting.

'Beurré Hardy' is a good and a popular Pear, but uncertain in cropping. I grow 'Clapp's Favourite,' but although attractive looking it scabs readily, and I should neither plant nor recommend it. 'Pitmaston Duchess' is a profitable variety, as some markets like it, but its flavour does not appeal to my palate. 'Dr. Jules Guyot' I consider an overrated Pear, but it appears to be a free and regular cropper, and may perhaps be considered worthy of inclusion in our list. 'Marguerite Marillat' is a large Pear of handsome appearance but awkward shape; 'Emile d'Heyst' appears to be a good cropper and is fancied by some growers, but my experience of both is limited. The Pear to which I have taken a great fancy and have planted (although my experience is limited to a few trees) is 'Laxton's Superb.' It is a very early and free cropper, apparently not subject to scab and of excellent flavour and texture if gathered early enough. I grow others, such as: 'Beurré d'Amanlis,' 'Comte de Lamy,' 'Glou Morçeau,' 'Durondeau,' etc., for which I have no particular enthusiasm or dislike, and am trying two or three trees of other recognized varieties of which I have not yet sufficient experience on which to base an opinion.

I fear my list contains more criticism than praise, but that may be all to the good, as an indication of my view that the Pear-grower should confine his attention to a very few varieties. The limitation of varieties suits the retailer, who receives every change with caution, and dislikes being told that such and such a variety is finished. His customers can be more readily satisfied by being offered a variety with which they are familiar. We growers quite appreciate the appeal that the imported Apples or Pears make to the retailer. Their quality and size are regular, and any particular variety is obtainable in any quantity for weeks on end. We must endeavour to satisfy the same requirements.

To sum up, I recommend 'Conference' and 'Fertility' wholeheartedly, with perhaps a few 'Pitmaston Duchess' and possibly 'Williams' Bon Chrétien,' 'Dr. Jules Guyot' and 'Laxton's Superb,' but before deciding consult your market salesman.

Concerning pollination, detailed figures have been published by Mr. Rawes, Mr. Hooper and Mr. Crane, and these can be consulted, but I do not anticipate any difficulty with the varieties suggested above.

The next step, the choice of a nurseryman, is important, but not difficult; go to a reputable firm, of which there is a number, ask for

their advice on varieties, and do not necessarily accept it; be prepared to pay a fair price for good stuff and do not buy bargain lots at sales. The type of tree I prefer is the bush form. Standard trees cannot be conveniently sprayed, thinned or gathered.

With regard to distance of planting, I should like to urge here my strong belief in wide planting; close planting costs more in the first instance, and I doubt whether, after, say, twelve years, one obtains any greater crop per acre. This is only my view, and refers to non-pedigree stocks reputed to be Quince; on 'Malling' Quince C it may be advisable to plant more closely, and if one put one's faith in the effect of root competition, 500 or more to the acre might not be excessive. But where land is available I think that ease of cultivation and spraying more than make up for the increased rent-charge per tree. Our aim now is to plant fewer trees to the acre, not let them grow too high, and induce them to crop lower down the tree. How often one sees very closely planted plantations with bare wood up to 5 feet from the ground! Our original planting was 10 feet by 11 feet—giving 396 trees to the acre; from 1916 onwards, 12 feet by 12 feet—giving 302 trees. This is too close for 'Conference' in my opinion, and in 1932–33 I planted 'Fertility,' 'Conference' and 'Laxton's Superb' at 14 feet square. I am now planning to plant, say, 2 feet farther apart in one direction, so as to leave a little more room for mobile spraying, in case I should wish to adopt this.

As some growers will consider this spacing rather wide, I include some figures showing the spread on July 20 of some of my trees planted in 1910, worked on what are believed to be Quince stocks and apparently still on Quince: 'Conference,' 14 feet, 'Doyenné du Comice,' 10 feet, 'Pitmaston,' 14 feet. 'Conference' and 'Doyenné du Comice' planted in 1924 both have a spread of 7 feet. The former only had their first real crop in 1933, and will soon cover more ground when their branches come down as a result of cropping. 'Doyenné du Comice' is scarcely yet cropping.

This problem of delayed cropping is one that is about to be investigated at East Malling. There are growers who claim to get crops of Pears five years from planting; our experience is that we have no difficulty in getting blossom, but cannot get fruit to set for a number of years. I have no records of the age at which our earlier planted Pears started to crop, but I believe all but 'Fertility' and 'Beurré d'Amanlis' were very slow.

Passing now to the cultural side, it is generally accepted that Pears should be done well, and I have not found that they can be overfed. Mine always get a dressing of several cwt. of 15 per cent. shoddy and steamed-bone flour. I have no evidence that potash is as great a necessity to Pears as it is to Apples, but I have recently been giving about 2 cwt. sulphate of potash per acre per annum in order to be on the safe side. In addition, complete spring dressings of artificials are sometimes given when there are prospects of a full set of fruit. Clean cultivation is practised except in certain places in the oldest plantations where the trees are very closely planted and the tractor cannot

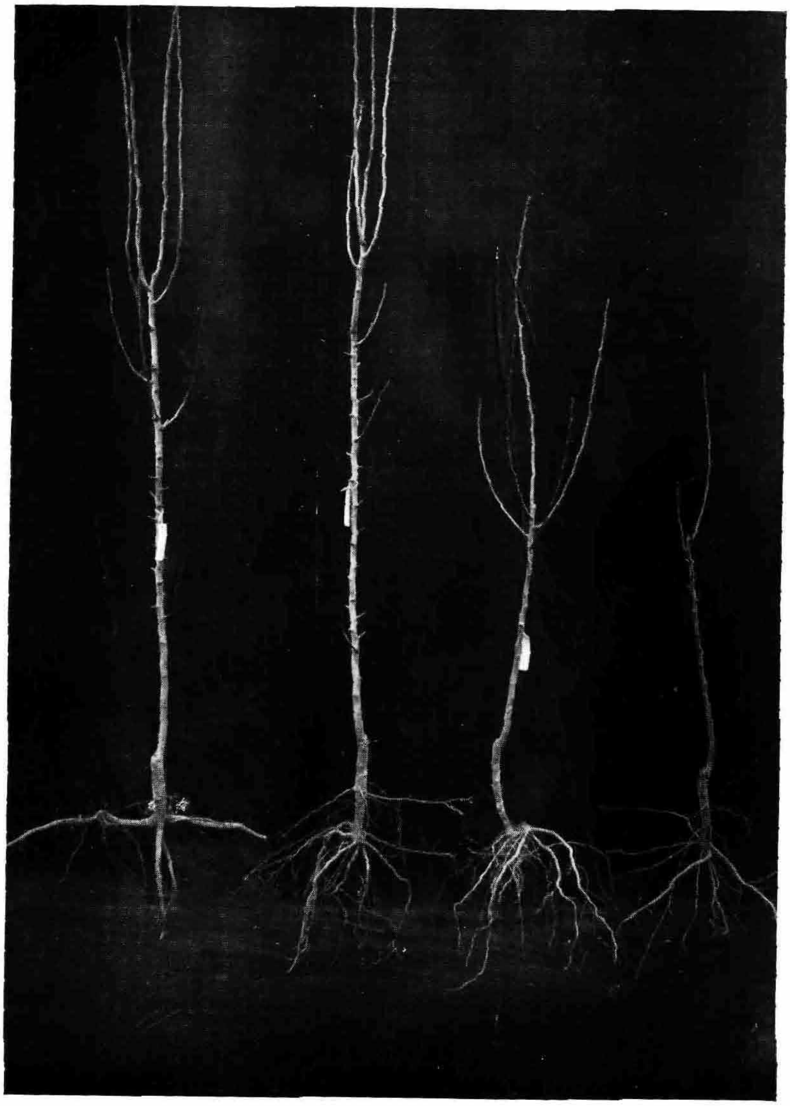

FIG. 20.—PEAR 'DR. JULES GUYOT' ON STOCKS C6, C2, C5 AND C3.

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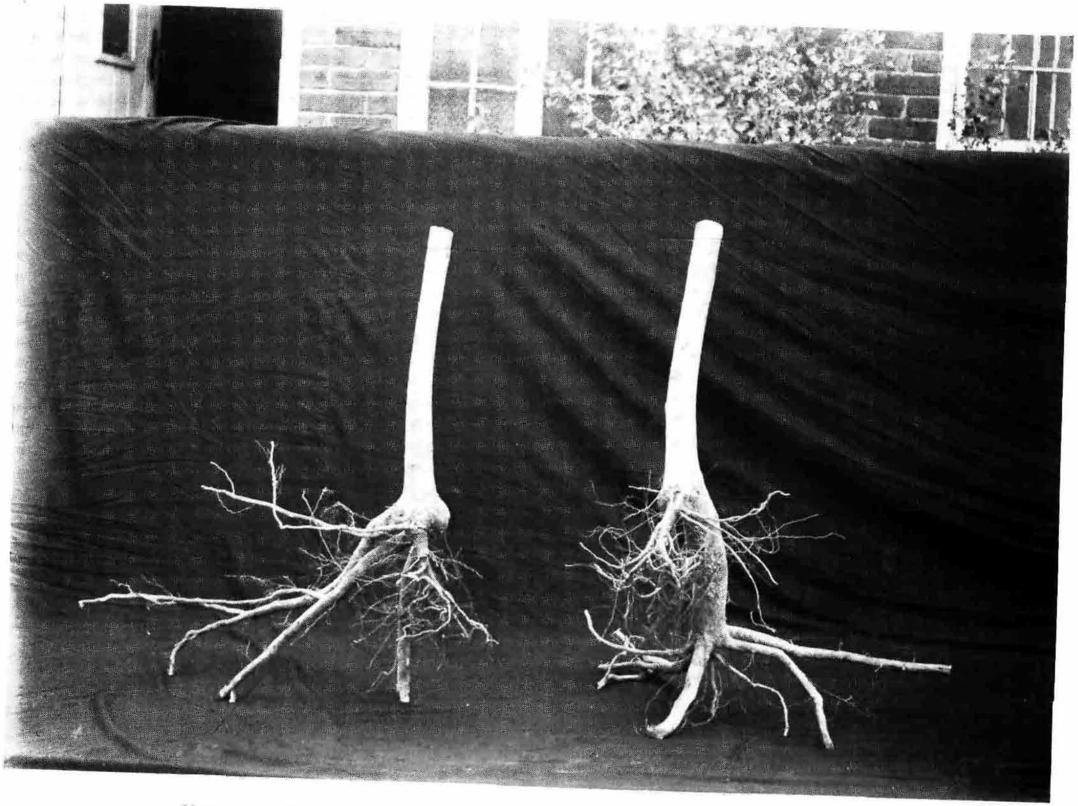

FIG. 21.—PEAR 'DR. JULES GUYOT' ON QUINCE C, SCION-ROOTED.

get through. As no obvious ill effects have been observed, two acres have been grassed down this spring; this will make life more comfortable for the poultry which are run in all plantations at the rate of about fifty to the acre.

The older plantations planted in 1909 are on varied stocks, many trees now being on their own roots. Since Quince stocks have been classified, 'Malling' Quince A has been used for working, and, more recently, 'Malling' C.

My ideas on pruning are in a state of flux. At present I am cutting young trees very hard for the first two or three years in an endeavour to get all my main branches to start fairly close together and then lighten my leader-tipping considerably, even to the extent of getting my tree rather floppy, in the belief that the strong upright growing tree comes later into cropping. I can fill up the centre of the tree later if I want to. The difficulty is to judge how hard the different varieties should be tipped in order to get them to form spurs; one has to find the happy mean between forcing the lower buds into too vigorous growth or having them remain dormant. With the older tree, pruning becomes a struggle to keep the spurs short; they are so apt to become long and bare, and our recent experiments seem to indicate much better setting of fruit when the spurs are cut back hard. In a pamphlet published in 1921 it was stated that the life of a tree on Quince was about fifteen years; many of our trees are twenty-five years old, and fruiting fairly well, but the fruit is not as large as it might be; whether due to the age or to lack of light and air through crowding, I cannot yet say. I am therefore attempting to rejuvenate some of them by beheading them at about 3 feet from the ground, and hope by this means to obtain on the young wood thus formed larger fruit than at present.

When I took to fruit-growing after the War, the question: "Spray or not spray?" was still being asked (I am told that in some quarters the question is still heard!) We very soon came off the fence on the spraying side, and our routine for years was Bordeaux once pre- and twice post-blossom, with lead arsenate if the usual anxious search for caterpillar found any number. Later, of course, I never looked for caterpillar; I take it for granted it is there, and give two pre- and two post-blossom sprays, with lead arsenate in at least three of them. Four years ago, red spider began to be a nuisance, so now I use lime sulphur at 3 per cent. before and 1 per cent. after blossoming, and more recently I have had to adopt tar oil washes to deal with aphis. In one plantation Pear midge causes considerable trouble, and chickens appear to have no effect at all on this pest, but it seems that pigs run fairly thickly on the ground in Spring check it to a considerable extent.

Picking is a task which is treated by many growers in too light-hearted a fashion. I have been criticized for my extravagant methods of picking, but after eleven months' hard work and heavy expenditure I do not care to risk damage to high quality fruit in order to save a penny or two a bushel. I will not consider piecework for this job, nor do I use picking bags. Pears are laid individually in orchard boxes or

in galvanized iron pails, which are cheaper and better than lined baskets, and if the picker cannot manage the pail at the top of the stool she hands the single fruits down to another woman. If buckets are used the Pears are then laid in trays, damaged ones being discarded, and taken carefully either direct to the grader for packing and despatch, or placed in cold store. For some years I have used an Ideal grader, which is designed for Pears, and supposed to be kinder to them than the Cutler, but I have ordered a Cutler for this season as I think it will grade more accurately and with no more damage, and handle larger quantities. I am, of course, not installing that abomination—a feeding table—I prefer to pick up each fruit individually, examine it and place it on the appropriate line according to quality. The half-box is used almost entirely, only the choicest fruits being placed in trays, with the exception of 'Doyenné du Comice' and 'Pitmaston Duchess,' for which trays are largely used. In all cases Pears are wrapped.

Marketing must be carried out in an orderly manner, by which I mean despatching the fruit in a package and in quantities which suit the particular market being supplied. To do this, we must make full use of the facilities provided by science in the shape of cold or gas stores. It used to be our practice to bring our Pears into our fruit room and lay them out on shelves until they began to "turn"—to use a well-understood expression. Sometimes, almost before we had finished laying out the later-gathered ones, the first ones of the same variety were ready to be marketed, with the result that some became too soft to stand the rigour of a train journey in a wicker-basket, and low prices were made.

It became obvious that no considerable quantity could be handled in this way, and a cold store was installed in 1924, so that all varieties of Pears can be sent to market in a firm condition in non-returnable boxes. The early varieties are packed as soon as gathered; if more are gathered than can be handled in a day, the balance is placed in cold store until we are able to pack them, but, of course, no attempt is made to store the earlier varieties longer than absolutely necessary, for this would delay the marketing of the later varieties. In some cases, Pears are despatched to cold stores adjacent to a market, held at 34° to 38° F., and drawn out by the salesman as required. My experience with a few tests of storing the early varieties is that they fail to ripen properly after any length of stay in store. 'Conference' and 'Doyenné du Comice' are the varieties I deliberately keep in store, in order that their selling periods may be lengthened by several weeks, and that I can, if necessary, keep them off the market until the majority of growers have finished. I have no fear of this being over-done, because the public are learning to ask for the 'Conference' Pear by name, but it will not win the place it should unless we are in a position to keep up supplies over a considerable period. I do not know how long it can be stored; I have not yet been able to resist the price it commands during November and, in any case, prefer to get it out of the way by the time I begin marketing 'Doyenné du Comice.'

'Doyenné du Comice' is not easy to store; under my conditions Christmas is the limit of its life, but work recently done in Victoria on the 'Williams' Bon Chrétien' Pear appears to indicate that a temperature of 32° F. gives the longest storage life and satisfactory ripening, provided that the storage period is not extended beyond the maximum for that variety, indicated by the first appearance of yellow. If stored beyond this period (twelve weeks in the case of 'Williams' Bon Chrétien') the Pear will not ripen normally. I hope research will shortly be done in this country along these lines on 'Conference' and 'Doyenné du Comice.'

I consider it a vast mistake for growers to send to more than one salesman in one market. I have done it in the past, largely for sentimental reasons, but I think one stands to lose more than one gains, and is simply putting up one's fruit to compete against itself.

In conclusion, I suggest that there is scope for expansion in Pear-growing in this country, but I suspect that the Pear is rather more particular about its environment than the Apple. Pears should therefore only be planted in localities where conditions are favourable, and by those who are prepared to grow them in the most thorough manner. If there are present any growers who feel an inclination to take up a branch of our industry which is full of interest and may yield a satisfactory financial return, I hope that to them my description of how Pears are grown under my conditions may have been of some practical value.

DISCUSSION.

Mr. W. TALBOT-EDMONDS: First of all, I should like to congratulate the R.H.S. on having this Conference. I should also like to congratulate them on getting commercial men to come and speak to commercial growers.

Mr. NEAME's paper has been on Pears. I have been interested in Pears for a good many years. I do not know whether I was born under a pear or an apple tree, but it was very near both. Like our Chairman's father, my father was a fruit-grower all his life. My brother and myself have both taken up fruit-growing on a fairly large scale, and we have done this differently in some respects from the majority of growers, for we distribute the fruit produced on our farms through Covent Garden Market.

Mr. NEAME in the latter part of his paper said stick to one salesman in one market. I can assure you that is very sound advice. Stick to one salesman in one market, send as big a bulk to him as possible, and keep sending it to him. Get a name for your fruit, grow it well, grade it well and pack it well. You are sure to have some rubbish left even after you have done that, but there is a market for it, especially for some special varieties of Pears. Find out the market where they can do with the small stuff, stick to that market, and have confidence in your salesman.

Mr. NEAME has mentioned only a few Pears that he considers

worthy of growing. I understand there are something like 140 or more varieties of Pears in this country. Is it not surprising that only four or five of those varieties have been tried and found to be a commercial proposition? There may be others, but we as commercial men have gone in for these few varieties.

The first thing we have to study is crop. It is no good having a variety of Pear with a wonderful flavour which sells well, but from which you do not get any profit. Mr. NEAME has mentioned the Pear 'Williams' Bon Chrétien.' I have great faith in it too; I plant it on Quince stock A as maiden trees, or in some cases two-year-old trees. I do not like the other portion of the name Williams—' Williams' Bon Chrétien.' The public at large do not understand these words. They have been educated for years by imported Williams, and the English-grown Williams—or Pears which are called Williams—on the barrows and in the shops, and the public know the Pear is of good quality and is, as Mr. NEAME said, "an honest Pear." I believe he said 'Conference' is an honest Pear, and so is Williams. Why is it? Because we know how to spray it. If you listen to the research workers or horticultural instructors you will hear 'Conference' is nearly immune from disease. Williams is not quite immune, but the scab of the Williams Pear can be checked quite easily. It will have scab as we all know, but it can be controlled even in trees of sixty years of age. I know Williams Pears in the Gillingham district forty-nine years old. For thirty-five years they only grew rubbish, but for the last five or six years—Mr. KENT has seen them—they have been grown perfectly and are a paying proposition. When you consider 7s. a half in a year like this it looks like a paying proposition for thousands of acres.

A few years ago I thought 'Fertility' was finished, but thanks to lime sulphur this is not so. The deterioration of 'Fertility' was caused by the black spot on the Pear, generally the forerunner of canker. Lime sulphur will eradicate black spot and you can grow 'Fertility' Pears as a paying proposition, though you may have to take even less than half the price you get for your Williams. It is a sound, good Pear, not only on Quince A—I know nothing about Quince C—but it is exceptionally good on Pear stock, even with continual dry weather such as we have had this year.

I have made these remarks about 'Fertility' because once 'Fertility' gets black spot it seems to poison the tree. We grubbed up many years back 'Fertility' planted twenty-four years ago, because we did not know how to control scab and the trees were absolutely ruined. The plot is now planted with 'Conference.'

'Dr. Jules Guyot'—I like to call it 'Jules'—is another honest Pear which crops and sells well. The public do buy this Pear with the eye and not for quality. It sells exceptionally well year in and year out.

I come to the old favourite 'Conference.' My father was fortunate enough thirty-nine years ago to have the gift from the late FRANCIS RIVERS of twenty-five 'Conference' Pear trees on Quince stock. I hope Mr. H. S. RIVERS is present. I should like him to know that these trees, thirty-nine years of age, are good friends to us to-day. They

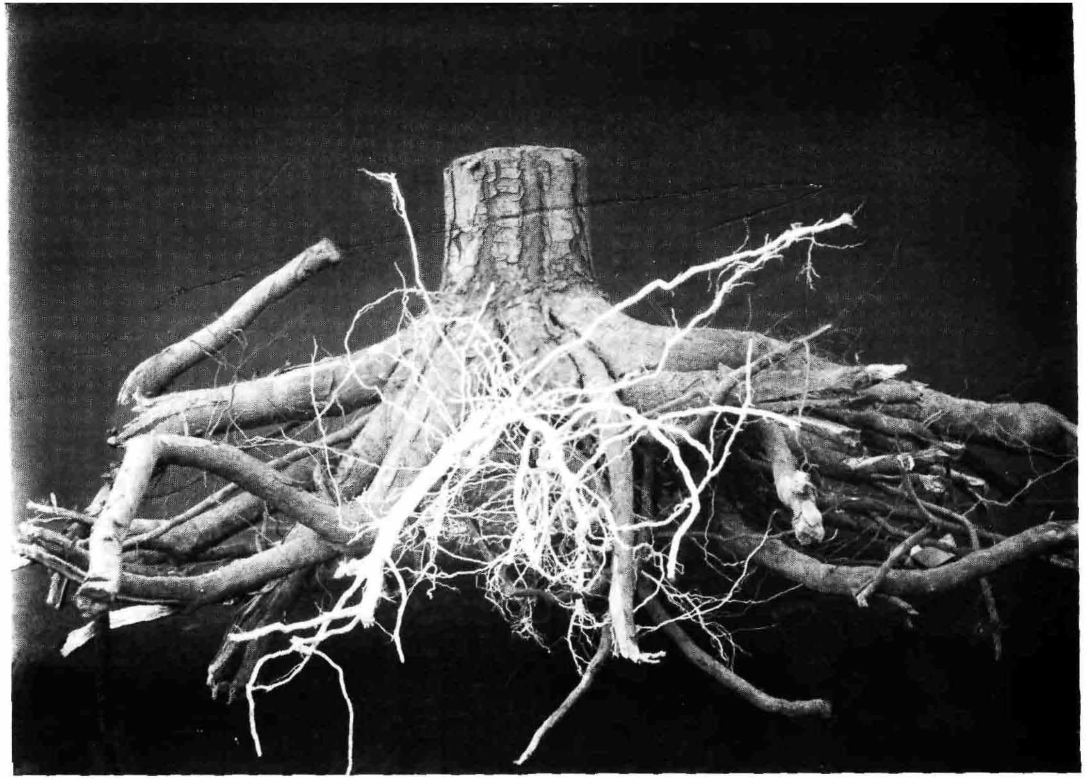

FIG. 22.—EIGHT-YEAR-OLD PEAR ON QUINCE, SCION-ROOTED.
Original Quince roots painted white.

[*To face p.* 152.

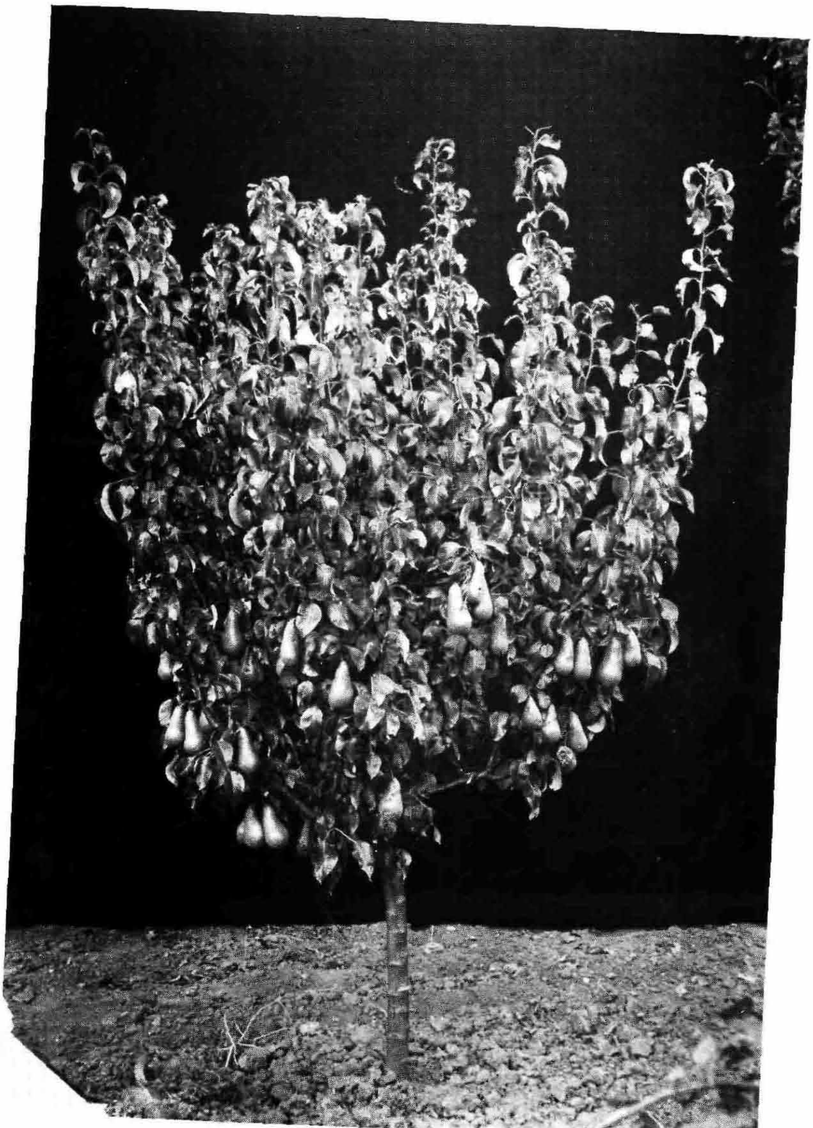

FIG. 23.—' PEAR CONFERENCE ' ON QUINCE A.
Seven years old.

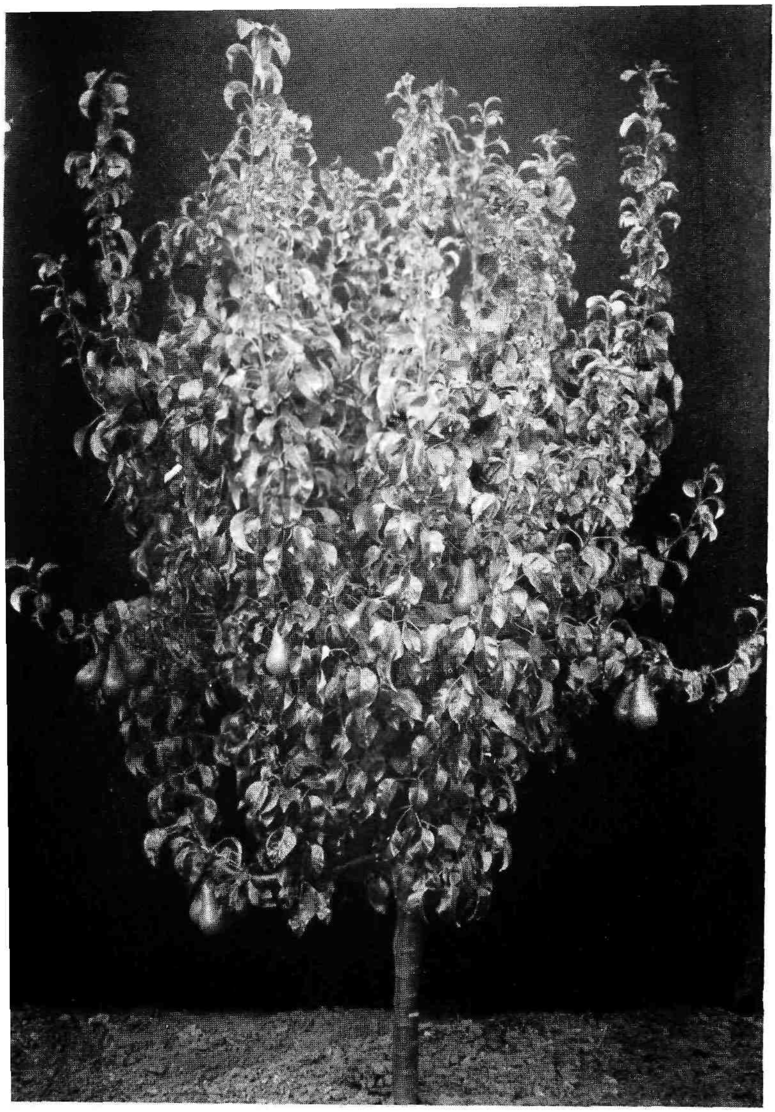

FIG. 24.—PEAR 'CONFERENCE' ON QUINCE C.
Seven years old.

[To face p. 152

crop well and bear real good fruit. A few years after that Mr. RIVERS wrote to my father and said he had a bed of 'Conference' Pear trees three or four years of age and he wanted my father to take them. Times were very bad in those days and he said to my father, "If you take those trees, they are two shillings a piece, and you need not pay for them for three years." They are thirty-four years old to-day and they have been real good friends. I can congratulate the RIVERS family, not only for bringing out 'Conference,' but other new varieties. 'Conference,' in my opinion, will never be overdone. We have a very large acreage of them; we sell huge quantities, and I believe now they go into every town in Great Britain and in Ireland, both North and South, and they keep coming for them.

'Conference,' like every other kind of fruit, has a fault. Do not plant 'Conference' in one block. It does not make any difference in the crop. You will get just as much weight, but you will get deformed, ugly-looking Pears. Even in a season like this you can get as many as 20 per cent. of these deformed Pears. There is a market for them, but it would be better if they were the Pear shape.

I do not know anything about 'Laxton's Superb' Pear. I believe it will come, but it is going to take fifteen years. Mr. NORBURY said this morning it is twenty years before the public know a fruit; I believe it will take another ten to fifteen years before the public will really know 'Laxton's Superb.' I am not growing it; I am studying it. The Pears I fancy are those I have told you about. I have no room for 'Comice' or 'Beurré Hardy.' I can grow wood and timber, but I cannot grow the Pears, and, as Mr. NEAME has told you, his 'Conference' comes out top even over 'Comice' and 'Beurré Hardy.' Perhaps the scientific work of the future will tell us how we can crop 'Comice' and 'Beurré Hardy.' They are two wonderful Pears and there may be a wonderful future for them, but I have not yet found a man anywhere in Great Britain, except just now and again in some seasons, with whom they will come out on top.

Mr. COOK: I should like to see something fresh brought forward at this Conference which will be useful for the future. It is not necessary to go into the new varieties of Pears. A good deal has been said about 'Fertility,' but the only good thing about it is that it is a good and regular cropper. I think there are other Pears which might be equally good croppers, or at least very nearly so. I would like to hear whether anyone here has had any experience of 'Marie Louise'? It is a regular cropper and very nearly approaches 'Fertility.' Of course, it is not a very high quality Pear, but it is better than 'Fertility.'

THE CHAIRMAN: Can anyone answer that question?

Mr. KENT: I have had experience with two trees at Wisbech. They were planted on Quince and I can endorse what Mr. COOK has said. They cropped with very considerable regularity, much more so than any other Pears that I grew out of about sixteen varieties, except perhaps 'Conference' and 'Beurré d'Amanlis.' On the soil at Wisbech it is rather dull in appearance, not too attractive, and not too good in quality, but it certainly did crop.

ROOTSTOCKS FOR PEARS.

By R. G. Hatton, M.A., C.B.E., V.M.H.

It is just twenty years since investigations upon rootstocks for Pears were initiated at East Malling. But since tradition has always emphasized that " He who plants Pears plants for his heirs," it is not surprising that many of the questions which it was then planned to try to answer still remain only partially solved.

The knowledge so far accumulated has at least taught that it is impossible even to generalize about Pears on the Quince and the Free (or seedling) Pear roots, so glibly referred to by horticultural writers of the seventeenth and eighteenth centuries.

Quince Rootstocks.

An examination of collections of Quince stocks in commercial circulation amongst representative European nurserymen showed that there were at least four varieties of Quince, readily distinguishable in spring and summer by their early foliage colour, leaf shape and general habit of growth. These features were described in detail and illustrated in 1920 (1).* Unfortunately, it had to be reported that these four varieties were often intermixed, and that there was neither uniformity in naming nor universal agreement as to which was the true ' Angers,' ' Common ' or ' de Fontenay ' Quince. There appeared to be, in addition, a number of slightly variant types (possibly seedlings) intermixed with these four predominating varieties, but, since they were only found in insignificant numbers, the actual multiplication and testing was confined to Types A, B, C and D, as these clonal selections were designated so as to avoid controversy over their nomenclature. The ' Portugal Quince,' frequently recommended by early writers as more vigorous than other varieties of Quince and therefore the best for delicate Pears, no longer appeared to be in use as a rootstock. However, the ' Portugal Quince ' of the twentieth century was procured and added to the other four as Type E for testing—with what results will be seen later.

There are now available for examination and analysis the individual tree records for cropping and certain expressions of growth on seven varieties of Pear budded upon this series of Quince rootstocks. In all, between four and five hundred trees have been under observation, and it is proposed to summarize and bring up to date the preliminary conclusions published in 1928 (2), when it became apparent that there was a considerable range of vigour and cropping habit exhibited upon any variety budded upon these five Quinces.

* *Figures in brackets relate to references on p. 166.*

Free Pear Stocks.

Before so doing, it is convenient to compare the existing knowledge with regard to the Free Pear stock and to refer to the generally accepted contrast between trees on Pear and on Quince roots. A report on this aspect of the investigations has recently been issued (3). Examination of a number of typical samples of the seedling Pear rootstocks of Europe showed them to be so varied botanically as to suggest that four or more less distinct species might be involved. Representatives of the range of variation within these "species" groups, called, for the purpose of the pomological experiments in view, Free Pear A to D, were described and classified from their foliage and growth characters, and some thirteen individuals were successfully multiplied by layering methods (some much more easily than others)—in order to build up clonal races for trials as rootstocks. These were initially budded with 'Dr. Jules Guyot,' chosen because of its traditional suitability for and free cropping habit upon Pear stock. Two of the selected families of Pear rootstocks proved "incompatible" to this variety after one year in the nursery, but there are now over 250 trees—half standards and bush—established and, in the main, flourishing upon vegetatively raised Pear stocks. Individual tree records of growth and cropping have now been made for six years. Striking significant differences in vigour have been found; trees on some series making twice the growth of others (fig. 20). Although these trees on different Pear roots have as yet borne practically no fruit, there are equally striking differences apparent in the number of fruit buds formed and the place where they are borne. These facts and the following figures suggest that whilst some Pear stocks may delay cropping, others may be expected to encourage early fruiting.

Table I.

*Comparison of Vigour and Cropping of Ten-Year-Old 'Dr. Jules Guyot' on Representatives of one Group of Layered Free Pear Stocks.**

Free Pear Stock.	No. of Trees.	Total Wood Growth in Metres.	Cross-Section of Stem. Sq. Cms.	Fruit Buds.	Fruit.	
					No.	Lb.
C 7	10	183	39	384	9	2·3
C 2	16	183	44	518	21	5·4
C 1	15	166	39	325	3	0·5
C 8	10	92	25	474	4	0·8
C 4	10	87	22	320	2	0·5

Trees on 'Quince' and 'Pear'—A Comparison.

Now that this range of vigour and fruit bud formation has been proved to exist amongst standardized races of Pear stocks, it would

* Although the crops are still small, the fruits harvested during the two subsequent seasons confirm these results.

be unwise to adhere too literally to the accepted generalization that whilst trees on Pear stock are vigorous and slow to crop, those on Quince are dwarf and comparatively quick cropping. Whilst this is probably undoubtedly true in the vast number of possible comparisons, there is now sufficient evidence to encourage the hope that one day it may be possible to produce a range of clonal Pear rootstocks. This would obviate the very striking disadvantages to the general use of Quince rootstocks in the nursery, where many combinations are known to be "incompatible" which involves the expensive process of "double-working," and in the plantation, where certain varieties are all too prone to establish themselves on their own roots in preference to remaining on their original rootstock.

The writer is not aware of the existence of any satisfactory data from which to compare the growth and cropping of different varieties on selected Pear and Quince roots. When the comparative tests of Pears on Quince were planted at East Malling, there was an insufficient number of vegetatively raised Pear rootstocks to allow of their inclusion. Unhappily, when these Pear rootstocks became available and the first trial was laid out, the scion variety chosen, 'Dr. Jules Guyot,' has proved so incompatible to the Quince stocks included for comparison that no trees on Quince roots are now surviving. As it will therefore be a number of years before such a comparative trial can be accomplished—trees are available on two varieties of layered Pear and Quince for the first time this autumn—it is thought worth referring to the small trial at East Malling (now twelve years old) in which trees on graded seedlings were planted out for comparison with similar varieties on known Quince roots. The one-year seedling Pear stocks were graded according to their "species" group—"Free Pear A, B or C. These were planted out in the nursery with layers of Quinces A and B and budded with 'Pitmaston Duchess,' 'Emile d'Heyst,' and 'Durondeau.' The number of trees ultimately available for planting out on these graded seedlings was very small and so does not permit of too serious comparison. The sets of trees varied from units of only four up to ten plants of each variety upon each seedling group. However, there are certain general points very easy for the eye to observe, and which figures do not belie where the facts are susceptible of numerical expression. A much darker green foliage is apparent throughout upon the trees on Pear roots. In 'Pitmaston Duchess' and 'Emile d'Heyst,' the trees on Pear roots are outstandingly more vigorous, but with the exception of one notable tree, this is not so in the case of 'Durondeau.' This is not only borne out by measurements of wood growth to the end of 1926 (6 years) and of height and spread (10 years), but is also confirmed by stem measurements at the present day (Table II).

Whilst it is not possible owing to the variability of the trees on Pear roots to detect differences between the different seedling groups, the comparisons between these and the trees on Quince are certainly valid. They suggest that the varietal factor must cut across any generaliza-

Fig. 25.—Pear 'Durondeau' on Quince A.

FIG. 26.—PEAR 'DURONDEAU' ON QUINCE C.
Twelve years old.

tion as to comparisons of growth on Pear and Quince. The very exceptional tree of ' Durondeau ' on Pear Seedling C—as well as a study of the individual records of other trees on these seedlings—emphasizes

TABLE II.

*Comparison of Twelve-Year-Old Trees * on Quince and " Grouped " Seedling Pear Roots.*

Mean Area in Square Cms. of Cross-Section of Stem, April 1934.

	Quince.		Pear.		
	A.	B.	A.	B.	C.
' Pitmaston Duchess ' . .	89 (13)	—	135 (4)	123 (5)	127 (4)
' Emile d'Heyst ' . .	—	68 (13)	129 (9)	131 (10)	138 (7)
' Durondeau ' . . .	—	61 (13)	57 (4)	72 (7)	98 (1)

that the varietal factor in the rootstock plays no less a part in qualifying any general statement.

One further general fact calls for notice in the records of cropping, as shown below :—

TABLE III.

*Comparison of Twelve-Year-Old Trees * on Quince and " Grouped " Seedling Pear Roots.*

Mean Crop in Lbs. per Tree to End of 1933.

	Quince.		Pear.		
	A.	B.	A.	B.	C.
' Pitmaston Duchess ' . .	15 (13)	—	4 (4)	10 (5)	6 (4)
' Durondeau ' . . .	—	70 (13)	9 (4)	18 (7)	4 (1)
' Emile d'Heyst ' . .	—	83 (13)	70 (9)	57 (10)	114 (7)

Whilst differential cropping in favour of the trees on Quince is almost certainly significant in the case of the first two in the table, it does not appear so by 1933 in the case of ' Emile d'Heyst,' which showed big differences in comparative size of trees on Quince and Pear ; in fact, this is mainly due to the " good behaviour " of individual trees. ' Durondeau,' on the other hand, which at present shows little difference in tree size—even though it shows striking differences in general character and habit—shows the biggest differences in cropping to date. Though it is true that the trees on Quince A and B generally have cropped earlier and more consistently than those on the Pear Seedlings, there is at least evidence that with some varieties Pear roots

* The number of trees is the figure in brackets.

may not lead to excessive vigour or undue delay in cropping. There the matter must rest for some time to come, whilst further selections and trials are made of Pear rootstocks from trees of good record.

Influence of Different Quince Rootstocks.

In view of the very complete details which were given of the objects, method and nature of these trials in 1928 (2), these can now be very briefly summarized before the measurements and weights are brought up to date and discussed.

Collections of the four varieties of Quince in commercial circulation (A, B, C and D) together with the 'Portugal,' 'Apple'- and 'Pear'-shaped (E, F and G), after being rogued of any apparent admixtures, were further propagated vegetatively and stem-budded with seven commercial varieties of Pear. Between February 1921 and December 1923 some 750 trees were planted out in permanent positions for detailed observation, whilst a good many more had given very definite indications in the nursery.

(*a*) *Suitability in the Nursery.*—Later results only go to confirm the four years consecutive nursery trials already reported. Of the seven Quince varieties tested only A, B and C are worthy of further consideration from the nurserymen's or fruit-growers' point of view. The common variety D, together with the named varieties E, F and G, has exhibited a very general incompatibility both at the end of one year in the nursery and in a delayed form subsequently in the plantation. In the few instances in which any number of trees have survived on Quince D, mostly with 'Conference,' 'Fertility' and 'Pitmaston Duchess,' these trees have been so variable in growth and disappointing in cropping that they are not worth planting. The incompatibility has manifested itself in slightly different forms in different seasons and with different varieties: a poor "take" of buds and frailty of the unions, with 'Durondeau' and 'Dr. Jules Guyot' in 1920–21, and with 'Conference,' 'Fertility' and 'Emile d'Heyst' in addition in 1922–23; small maiden trees as in 'Pitmaston Duchess' in 1920–21, and 'Conference' in 1919–20. There has been no sign of the incompatibility of any of the seven scion varieties used with Quinces A, B and C. There has rarely been any significant difference in the height or weight or union of the maiden trees.

(*b*) *Delayed Incompatibility in the Plantation.*—On the unsatisfactory rootstocks, a high percentage of even apparently healthy maidens have subsequently died. In the first series of 'Conference' trees, only nine on D out of an original sixteen survive to-day. The others died over a period of seven years. In the second trial with the same variety, planted a year later, two trees are dead and six more very poor, out of sixteen trees on D. In a similar trial of 'Fertility,' one tree on D has now died and a further five have never grown, out of a total of twenty trees. Three out of eight trees of 'Doyenné du Comice' on this stock had died within four years of planting. In other cases,

where the original trees have survived and eventually grown strongly, they have only too often established themselves on their own roots, as will be shown later. The record of the trees on E, F and G is for the most part even worse. No such story of the progressive evidences of incompatibility can be told of trees on Quince A, B or C, with the possible exception of 'Dr. Jules Guyot' (which does not appear really normal on any of the Quince roots), and three trees in the first series of 'Conference' on A which are considerably more dwarfed than the rest and, as reference to the cropping records show, started earlier into fruiting. These trees have neither the poor foliage nor unthrifty appearance of the incompatible trees already referred to, nor does a position factor appear to explain their character. It is intended one day to examine the union between stock and scion, and to investigate whether some "fault" is a possible explanation of their exceptional behaviour.

(c) *Effect of Quinces A, B and C on Vigour and Cropping Vigour.*—In 1928 the figures, with few exceptions, showed no significant differences in the vigour of trees on A, B and C, though the oldest trees (then 9 years) suggested that those on A and B were getting a "slight lead" over C, and it was thought that this might not be unconnected with the comparative fruiting records on these stocks to date. Actually up to the end of five years, with almost all varieties, trees on C were significantly slightly more vigorous—a valuable asset in forming a young tree quickly. At the end of this period most of the trees on C were becoming distinctly more spreading than those on A and B—another symptom of the effect of early cropping. After the first five or six years it has generally been found impossible to continue measurements of all new wood growth upon these trees, and since height and spread of tree must of necessity be rather arbitrary, the area of the cross-section of the main stem (trunk) must be regarded as the most satisfactory measure of "vigour" available for comparative purposes. These calculations are here presented both when the various sets of trees were nine years old, and again when the last girth measurements were made at the end of 1933.

With the exception of 'Pitmaston Duchess,' 'Beurré Hardy' and 'Doyenné du Comice' on Quince B (and 'Conference' on D) none of the differences at the end of 9 years are significant, and as the 1928 report said there was lacking "ocular demonstration to show a falling off in vigour" on Quince C. The exceptional growth of the above-mentioned varieties on B, at least in the case of 'Beurré Hardy' and 'Doyenné du Comice,' seems entirely due to a positional factor. Two trees of each, outstanding in size, occur close together on one part of the plot only.

By 1933, however, the picture both in the plantations and as shown in figures is a very different one. It is now obvious that in practically every case the trees on C are the smallest. In four cases ('Conference,' 'Beurré Hardy,' 'Doyenné du Comice' and 'Durondeau') out of seven, the area of cross-section of stem of trees on C is now significantly smaller than that of trees on A or B, and in one ('Pitmaston Duchess')

TABLE IV.

Relative Vigour of Different Pear Varieties upon Different Quince Roots shown by Area of Cross-Section of Stem in square cms.

Variety.	Age at End of 1933.	No.	On Quince. A. End of 9 Yrs.	A. End of 1933.	B. End of 9 Yrs.	B. End of 1933.	C. End of 9 Yrs.	C. End of 1933.	D. End of 9 Yrs.	D. End of 1933.
'Conference'	14 yrs.	(16)	39	79	39	84	36	67	—	—
'Conference'	12 yrs.	(16)	36	71	39	**78**	30	61	**23**	58
'B. Hardy'	13 yrs.	(8)	75	162	**90**	195	70	**132**	None worked	
'Doyenné du Comice' . .	13 yrs.	(8)	49	93	**60**	122 (6)	48	**78** (7)	Only 1 left on Quince	
'Durondeau'	13 yrs.	(8)	37	66	37	66	30	**49** (4)	None left on Quince	
'Pitmaston Duchess' . .	13 yrs.	(8)	51 (7)	84 (7)	**68**	107 (7)	48 (3)	83 (3)	None left on Quince	
'Fertility'	10 yrs.	(20)	56	**62*** (2)	42	46*	41	47* (3)	61	83* (11)
'Dr. Jules Guyot' . . .	13 yrs.	(8)	20 (4)	33 (4)	15 (1)	27 (1)	14 (3)	25 (3)	None worked	

* The last measurement was made in 1932 when the trees were ten years old.

Note.—The figure in brackets represents final number of trees not scion rooted. The figures in this table have been examined statistically and significant differences are shown in heavy type.

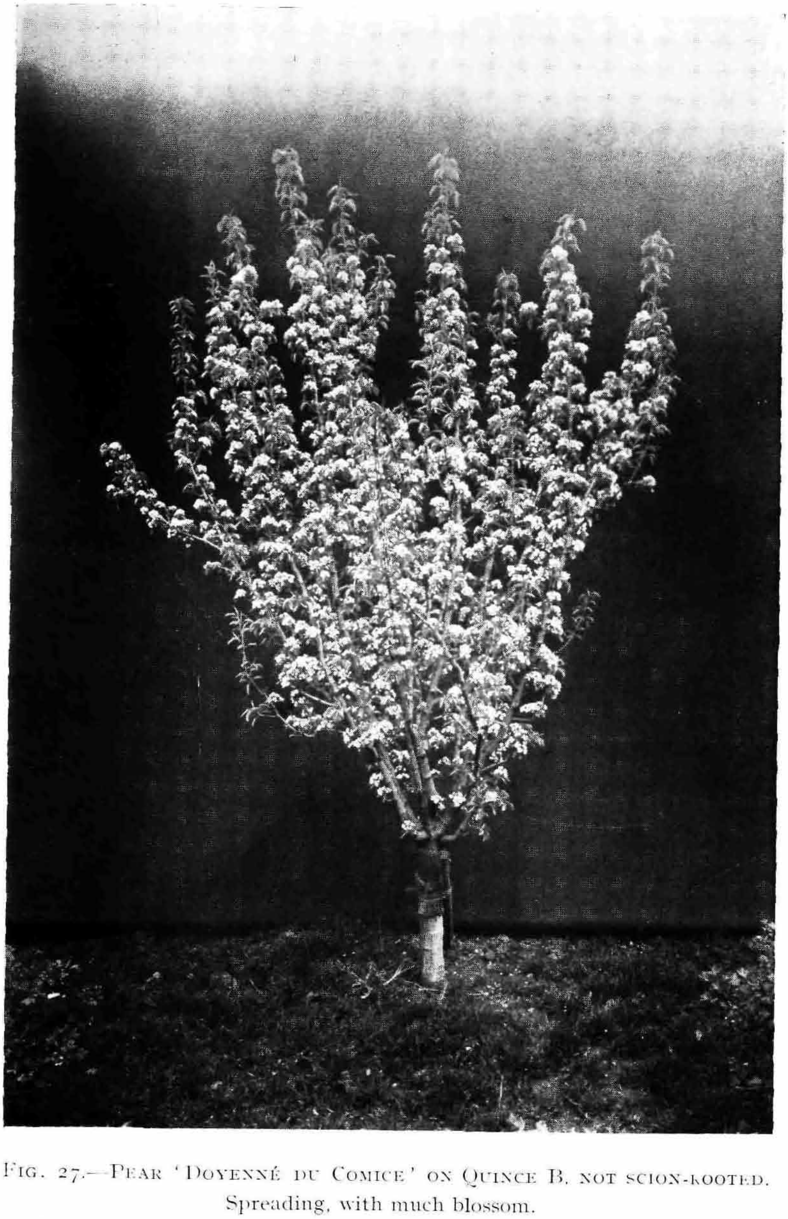

FIG. 27.—PEAR 'DOYENNÉ DU COMICE' ON QUINCE B, NOT SCION-ROOTED.
Spreading, with much blossom.

[To face p. 160.

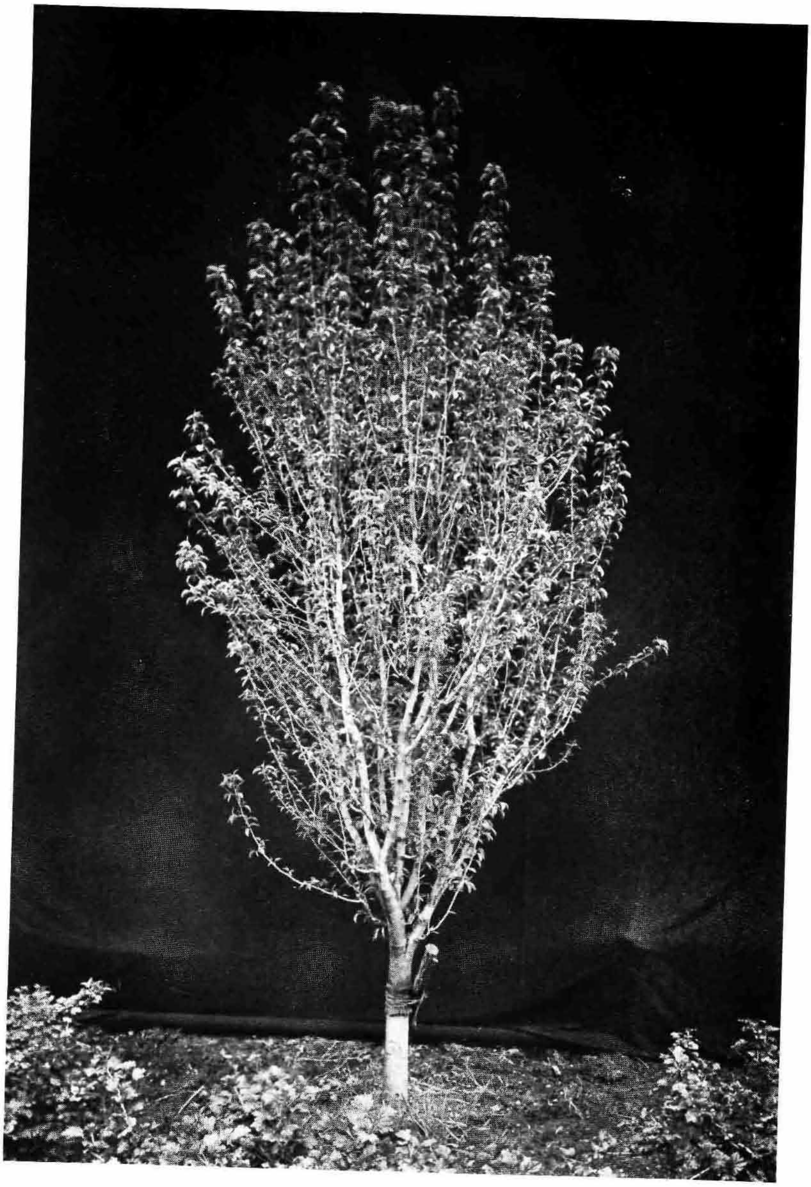

FIG. 28.—PEAR 'DOYENNÉ DU COMICE' ON QUINCE, SCION-ROOTED.
Erect, no blossom.

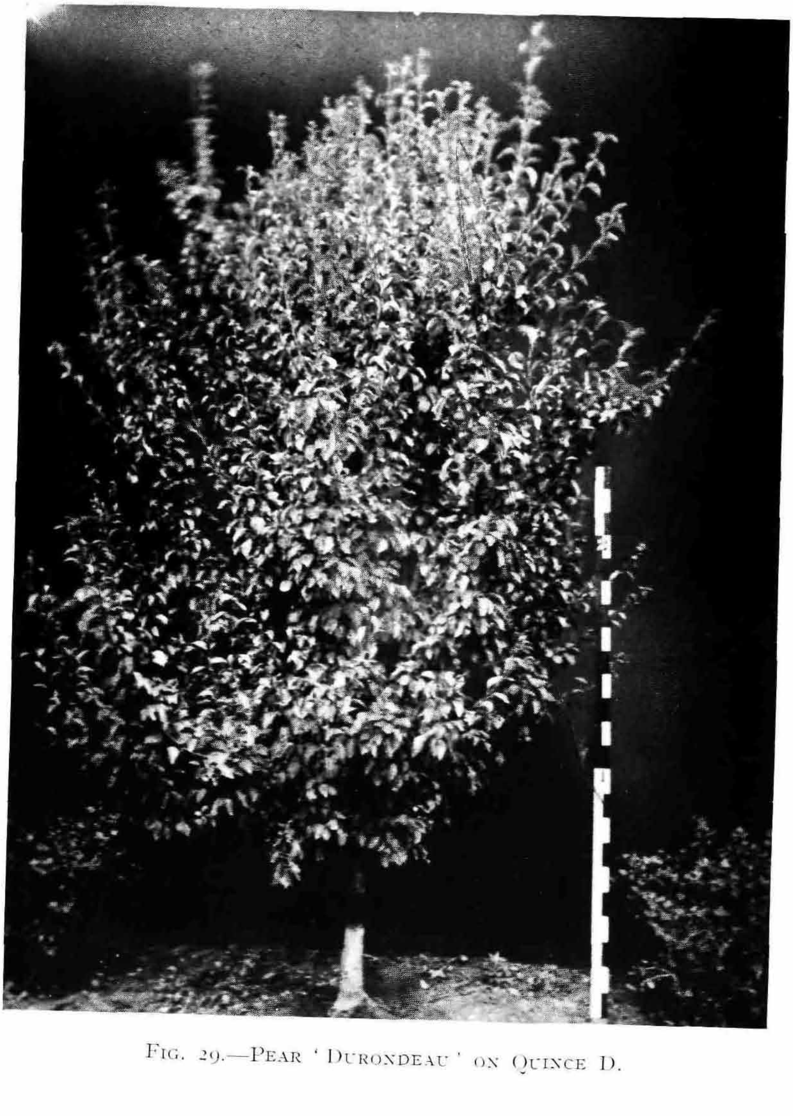

FIG. 29.—PEAR 'DURONDEAU' ON QUINCE D.

FIG. 30.—PEAR 'DOYENNÉ DU COMICE' ON QUINCE D, NOT SCION ROOTED. Dwarfed, incompatible.

[To face p. 161.

it is significantly less than that on B. The only exceptions, 'Fertility' and 'Dr. Jules Guyot,' as will be shown later, are of doubtful value, owing to complicating circumstances of scion-rooting in the former and the small number of surviving healthy trees of the latter on any Quince roots.

Quince C, like Apple rootstocks Nos. IV and VII, has, after an initial period of both vigorous growth and cropping, apparently settled down definitely as a dwarfing stock. The questions which arise with regard to all dwarfing rootstocks naturally occur. How long will it last? Will it keep on growing? How close is it safe to plant it? At one time it was thought that Pears on Quince only lasted about fifteen years, but the 'Conference' trees on Quince C at East Malling are still making some leader growth in their fifteenth year despite a drought and a heavy crop.

Cropping.

When the 1928 Progress Report was issued all the varieties worked on Quince C had given the earliest fruits. The following crop weights (p. 162) complete the picture to date.

It will be seen that when all the sets of trees had reached nine years of age the situation was not very different. In five out of the eight comparisons, trees on C are still cropping significantly more heavily than on A or B, and in a sixth more heavily than on A. There had been practically no crops on 'Doyenné du Comice' up to that period, but as soon as this variety began to fruit the trees on C bore most heavily. The two apparent exceptions, as in vigour, were 'Fertility' and 'Dr. Jules Guyot,' but the true results on both these sets are again doubtful.

At the end of 1933, when the sets ranged from twelve to fourteen years old, trees on C had retained their significant lead in cropping in four out of the six valid comparisons; in the oldest series of 'Conference' and the variety 'Durondeau' there was no significant difference between the cropping of trees on any of the three Quince stocks. In 'Buerré Hardy' and 'Pitmaston Duchess,' trees on B have by 1933 given significantly greater crops than on A—and this is not due to the trees of exceptional vigour in a good location already referred to, since they in actual fact have given the smallest crops on B. With the single exception of 'Fertility,' all remaining trees on Quince D, although normal in growth, have given notably poor yields.

As in the case of the retention of vigour, these advantageous cropping figures on Quince C arouse all sorts of speculations. The trees are now definitely smaller. Will their crop diminish or remain stationary whilst those on A and B increase? Even then, in the light of the pre-eminence of these trees up to ten years or more, would it pay better to plant them more closely and so secure heavy fruiting and early crops per acre? The first season's crop of 'Conference' on the fourteen years old series on Quinces A, B and C shows some suggestive results.

TABLE V.

Comparative Cropping of Different Pear Varieties on Different Quince Roots. Fruit in lb. per Tree.

Variety.	Age at End of 1933.	No.	On Quince.							
			A.		B.		C.		D.	
			End of 9 Yrs.	End of 1933.	End of 9 Yrs.	End of 1933.	End of 9 Yrs.	End of 1933.	End of 9 Yrs.	End of 1933.
'Conference'	14 yrs.	(16)	9	148	6	155	**18**	170	5	45
'Conference'	12 yrs.	(16)	18	65	21	87† (8)	**42**	**124**	15	47 (8)
'Fertility'	10 yrs.	(20)	67	131* (2)	64	98* (13)	50	82* (3)	53	89*
'B. Hardy'	13 yrs.	(8)	2	55	4	104	**13**	**130**	None worked	
'Doyenné du Comice' . .	13 yrs.	(8)	4	22 (8)	0	30 (6)	2	**52** (7)	2	19 (1)
'Durondeau'	13 yrs.	(8)	25	97	40	114	40	118 (4)	1 (?)	None left
'Pitmaston Duchess' . .	13 yrs.	(8)	5	32 (7)	4	64 (7)	**12**	**90** (3)	2	None left
'Dr. Jules Guyot' . . .	13 yrs.	(8)	23	60 (4)	18	40 (1)	14	38 (3)	None worked	

* Last crop in 1932.
† Eight trees were removed, but were not dwarfed or scion-rooted.

Note.—The figures in brackets represent ultimate number of trees still on Quince roots, otherwise the numbers remain as in column 3. The figures in this table have been examined statistically and significant differences are shown in heavy type.

Whilst there is no significant difference between the *number* of fruits upon any of the stocks, the crop off Quince B is significantly *heavier* than off C, there being 4·6 fruits to the lb. on B, as against 5·5 on C. (Trees on A hold an intermediate position.)

On the younger series of ' Conference ' the total weight and size of the fruit off B is significantly greater than off both A or C. Preliminary records of the 1934 crop from 'Beurré Hardy' point in the same direction, the crop off A falling strikingly behind those off B and C, but this single season's cropping result is insufficient ground for recommending the use of Quince B in preference to A, though, as the comparative tables show, it has proved up to the present to be at least as valuable.

Up to this season there has been no obvious contrast to suggest an economic difference in size of fruit off the various stocks, and even now it cannot be said that the fruit off C is unduly small. However, this tendency suggests that early heavy cropping, as with No. IX apple stock, may end in small fruit if cultural and manurial treatments are not specially adapted to this type of tree.

Whilst, therefore, the present season's heavy crop seems to show that the trees on C are not finished, time alone can answer these questions fully. However, Quince C has been notably successful in bringing into earlier bearing the more shy, and therefore more remunerative varieties of Pear such as ' Doyenné du Comice ' and ' Pitmaston Duchess,' and this fact alone seems to justify its recommendation for commercial trial. There is little doubt that it is ideal for well-fed garden soils where even the marked dwarfing effect upon such heavy cropping varieties as ' Durondeau ' would be compensated by high feeding.

The evidence in favour of giving a preference to Quince B over Quince A for general run of vigorous bush Pears is up to the present too slight to warrant any recommendation. It appears that there may be varietal preferences—such as that of ' Beurré Hardy ' for B or ' Dr. Jules Guyot ' for A—which can only be discovered as opportunity offers. From the point of view of the tree-raiser, there is no doubt that Quince A is the most satisfactory to handle and Quince C the least, owing to their respective vigour. However, there is no doubt that the nurseryman will be prepared to supply trees on C if the grower provides the demand. There should by now be available an adequate supply of true Quince C.

Scion-Rooting.

Although the phenomenon of scion-rooting was recognized and indeed described in some detail in the case of 'Durondeau' on the unsuitable Quince G roots, when the Progress Report was published in 1928, the full significance of it has only become apparent subsequently [4].

The doubtful value of the figures presented for the varieties ' Fertility ' and ' Dr. Jules Guyot ' in Tables IV and V has already been hinted at. The reason for this will now be explained. In view of too close planting, it became necessary in 1932, when the ' Fertility ' trees

were only ten years old, to remove them. It had already been recorded that some of the trees on the less compatible Quinces D–G had suddenly become exceptionally upright and vegetatively vigorous, and that this was probably due to scion-rooting, but, when the series was lifted as a whole, no fewer than 41 out of 75 trees examined were found to be already scion-rooted to a greater or less extent. At the time of planting the points of union between stock and scion of all the young trees in the Pear rootstock experiments had been purposely left just above ground level so as to guard against this possible contingency. Unfortunately, in the course of normal cultivations the soil has been drawn towards the trees, which have undoubtedly " settled down " in the ground. This has enabled scion-rooting to take place. Of the trees of ' Fertility ' on Quince A, 70 per cent. showed scion-rooting, 35 per cent. on Quince B and 85 per cent. on Quince C. Now, in looking back over the records of cropping, it was found that as is general the set of trees on C had fruited most heavily up to the end of seven years (1929) ; after that date differential rootstock effect on crop becomes less apparent. Although this may partly be due to the naturally heavy bearing habit of ' Fertility,' the main reason is obvious now that it is known that the trees had been scion-rooting for some years.

An adjoining planting of young trees of ' Dr. Jules Guyot,' ' Emile d'Heyst ' and ' Durondeau '—trees not included in the figures presented in the Tables—was also lifted and examined. Fifty out of eighty-two trees of ' Dr. Jules Guyot ' showed that the scion had rooted—this time 36 per cent. on A, 61 per cent. on B, and 86 per cent. on Quince C. Twenty-seven out of forty-eight trees of ' Emile d'Heyst' had behaved similarly—20 per cent. on A, 36 per cent. on B, 67 per cent. on C, and 100 per cent. on D and E. Eleven out of thirty-six trees of ' Durondeau ' were scion-rooted—10 per cent. on A, none on B and C, and 100 per cent. on D and E. These facts made it essential that a very careful examination should be made of the other experimental plantings of Pears. The earth was scraped away from around the collar of every tree to facilitate an examination of the union. Roots which came from above (*i.e.* the scion) and from below (the rootstock) could usually easily be identified, but where there remained any doubt the roots were left exposed for a period, and it was found possible to determine accurately by the size and appearance of the lenticels which were Pear and which Quince roots. A microscopical examination of root sections also formed a valuable final court of appeal.

It should be added that once a tree has become seriously established on the scion's roots it is readily detected by the exceptionally upright vigorous growth and large dark green foliage.

Although there are far more trees of ' Conference ' than of any other variety, in no single instance has a tree been found to have scion-rooted, nor have any of the trees of ' Beurré Hardy.' On the other hand, the details given below show that even on Quinces A, B and C some serious scion-rooting has occurred with the other four varieties used in these investigations.

TABLE VI.

Mean Crop in Lbs. of Four Varieties on Quince Stocks and Scion-rooted to 1933.

On Quince Stock.		'D. du Comice.'		'Durondeau.'		'Pitmaston D.'		'Dr. Jules Guyot.'	
		No. of Trees.	Crop.	No. of Trees.	Crop.	No. of Trees.	Crop.	No. of Trees.	Crop.
A	Still on Quince	8	22	8	97	7	32	4	60
	Scion-rooted	0	—	0	—	1	7	4	31
B	Still on Quince	6	30	8	114	7	64	1	40
	Scion-rooted	1	23	0	—	1	44	5	34
C	Still on Quince	7	52	4	118	3	90	3	38
	Scion-rooted	1	18	3	76	5	40	3	36
D	Still on Quince	1	19	0	—	0	—	None worked	
	Scion-rooted	4	2	5	6	4	8	—	—
E	Still on Quince	2	7	1 *	41	4	37	0	—
	Scion-rooted	6	1	6	2	4	12	7	19

A very high proportion of all four varieties have scion-rooted on the unsuitable Quinces D and E; but even on A, B and C 9 per cent. of the 'Doyenné du Comice,' 14 per cent. of the 'Durondeau,' 30 per cent. of the 'Pitmaston Duchess,' and 60 per cent. of the 'Dr. Jules Guyot' have now developed scion-roots, and nearly double the number of trees on Quince C as compared with those on A and B. Thus varietal and rootstock influences are both apparent. However, the most instructive lesson to be learned from Table VI is from a comparison of the average crop weights from the scion-rooted trees and those still on Quince. The very striking reduction in cropping of scion-rooted trees is notable. It is certainly true to say that most Pear plantations and probably the majority of fruit gardens are carrying no small number of these "passenger" trees as the fruit-grower has come to designate them. In the past he has even avoided using them as a source of bud or graft wood because of their sterility, and has regarded them as "rogues." In many cases it has been found that the Quince roots are completely dominated if not all dead, and it remains to be seen whether these trees after a further period of years will return to normal cropping, or can be induced to do so by ring barking or other methods. Unfortunately the rank growth not infrequently seems to lead to very severe scab infection. There is some slight evidence that if the tree has been growing normally on a compatible Quince stock, and has begun to crop to any extent before scion-rooting, the results on fruiting are less detrimental than when the variety gets away on its own roots quite early in its career or after a period of extreme dwarfingness on an incompatible rootstock. A variety such as 'Dr. Jules Guyot'—or even a very heavy cropper such as 'Fertility'—

* Just starting to scion-root.

which naturally responds to the immediate check of a Quince rootstock, may continue to crop fairly satisfactorily when growing subsequently upon its own roots.

There is evidence at East Malling to show that this phenomenon is by no means confined to Pear varieties upon Quince roots. Several examples have been found both on seedling Pear roots and upon some of the layered Pear stocks which proved incompatible. At one time a series of ' Fertility ' trees was raised upon rootstocks which included other forms of Pyrus such as the ' Mountain Ash ' (*Sorbus Aucuparia*), the ' Wild Service ' (*Sorbus domestica*), and the ' White Beam ' (*S. Aria*). When this plantation was dug up at ten years old, all the trees which had survived and made any growth on these stocks were found to have established themselves on their own roots.

It appears to be very important to prevent scion-rooting and that the obvious method for future plantings is twofold. The buds must be inserted higher up on the stem of the rootstock, and especial care must be taken in planting to ensure that the point of union will ultimately remain well above ground.

Acknowledgments.

Mr. J. Amos has been associated with the writer throughout the conduct of these experiments, and many of the junior pomological staff have assisted in accumulating the records. Mr. T. N. Hoblyn has assembled and discussed the figures, and his staff have undertaken the necessary computations. To all those associated with the experiment the writer's best thanks and acknowledgments are due.

References.

[1] Hatton, R. G., " A First Report on Quince Stocks for Pears." *Journ. R.H.S.*, **45**, 269–277.

[2] —— " The Behaviour of Certain Pears on Various Quince Rootstocks." *Journ. of Pom. & Hort. Sci.*, 1928, **7**, 216–233.

[3] —— " ' Free ' or Seedling Rootstocks in use for Pears : Their description, selection, vegetative propagation and preliminary testing." *Journ. of Pom. & Hort. Sci.*, 1933, **11**, 305–334.

[4] —— and Bagenal, N. B., " Scion Rooting at East Malling Research Station." *East Malling Res. Sta. Ann. Rep. for* 1933 (May 1934), 243–246.

STORAGE OF APPLES.

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When considering the problem of apple storage it is convenient to deal separately with the four main factors which influence the storage life of the fruit. These factors are:

(1) The inherent keeping quality of the variety;
(2) The pre-storage conditions, such as climate, season, soil, cultivation, manuring, pruning, type of rootstock used, orchard sanitation, methods of gathering and grading the fruit, etc.;
(3) The stage of maturity of the fruit when gathered, and when stored;
(4) The actual conditions of storage.

The Inherent Keeping Quality of the Variety.

It is unnecessary to emphasize here what is already known in this direction.

The Pre-Storage Conditions.

Although striking examples can be given, not only from the results of storage trials, but also from the actual experience of growers, to show the marked effect upon the keeping quality of apples, of orchard and other pre-storage conditions, many difficulties are encountered when one attempts to obtain useful generalizations from the available data. A few statements of fairly wide application can, however, be made.

Climate and Season.

For home-grown apples very few precise data are available with regard to the effect of climate on the storage life of the fruit. Experiments carried out over a number of seasons with 'Bramley's Seedling' apples have indicated that there is no obvious correlation between the weather conditions during a complete growing season and the storage life of the fruit. There is some evidence, however, that good keeping quality is associated with warm dry weather during the few weeks preceding the date of gathering. In the U.S.A., on the other hand, the effects of climatic conditions are more obvious. For instance, it is well known that such varieties as 'Northern Spy,' 'Baldwin' and 'Rhode Island Greening,' grown in the Cumberland-Shenandoah Valley region or in the hot irrigated valleys of the Pacific

Northwest, are very short-lived in storage, although suitable for all-winter storage when grown in New England, New York, Michigan, and other northern producing districts.

Cultural Conditions.

Apples intended for storage should be grown under conditions which will produce the best keeping qualities. For instance, it is now fairly well established that to obtain good keeping quality in most varieties of apples, the minimum quantity of nitrogenous fertilizer that will produce adequate growth should be applied to the soil, but with plenty of potash and phosphate. Great care should be taken to grow clean fruit, that is, fruit free from scab, insect punctures and other defects. An important but less obvious point is to keep the orchards and packing-sheds free from decaying fruit, etc., on which the spores of apple-rotting moulds may be produced.

Rootstock.

Although the view is frequently put forward that the apples produced on certain rootstocks are good keepers or the reverse, little exact information is available. Experiments recently carried out with 'Bramley's Seedling' apples have failed to substantiate this view. The effect of rootstock varies according to type of soil, manurial treatment and other factors.

Gathering, Grading, etc.

When gathering the fruit, it should be handled with the utmost care. Strigs should not be pulled from the fruits; individual fruits should be placed gently in the orchard boxes rather than dropped or rolled from baskets or bags; and during transport to the store every effort should be made to avoid bruising and rubbing the apples. No fruit showing any form of mechanical damage involving fracture of the skin should be retained for storage.

It is usually advisable to grade the apples for size before they are placed in storage, and to exclude the extra large specimens.

For long-period storage of apples the procedure of wrapping the fruit in oiled tissue paper is strongly to be recommended. Oiled wrappers not only control superficial scald or skin browning, but in some way, not yet fully understood, tend to preserve the fresh appearance of the fruit. Whereas in cold storage the use of oiled wrappers is essential only in the case of certain varieties which are particularly susceptible to scald, for example, 'Newton Wonder' and 'Annie Elizabeth,' in gas storage on the other hand most varieties of apples are liable to scald unless oiled wrappers are used.

The Stage of Maturity of the Fruit when gathered, and when stored.

Experimental evidence has shown that the widespread belief among fruit-growers that there is an optimum time for gathering

apples intended for storage is fully justified. Although fruit picked when immature is generally found to keep the longest it tends to shrivel and rarely attains perfection of colour, texture and flavour. On the other hand, if the fruit is left on the tree until its characteristic aroma is present and the seeds are brown it will probably show rapid wastage in storage. It follows therefore that a stage between these two extremes should be aimed at, and in this connexion the simple test, often adopted by growers, of gently twisting the apple on its stalk to ascertain whether it will part readily from the tree may, for the want of a better one, be recommended.

After gathering, apples should be placed in storage with as little delay as possible. Attention should be drawn to the important relationship which exists between the degree of maturity of the fruit when cooled down and the development of breakdown in cold storage. This point is dealt with in the following section.

Storage Conditions.

(a) *Temperature.*—It is not always realized that the apple when gathered from the tree is a living organ and that it continues to respire and to generate heat. Carbon dioxide is given off together with other volatile substances and oxygen is absorbed from the air. The fruit, however, is now deprived of its source of nutriment and must exist on the reserves which were accumulated during the growth stage. The problem which the grower has to face is how best to keep the fruit whilst it is passing through a period of progressive ageing and starvation so that it may emerge after storage as sound and attractive as possible.

Temperature plays a most important part in determining the rate at which these ageing or ripening processes proceed. It is, of course, a well-known fact that most chemical and physiological reactions, such as those which occur in living plant tissues, are slowed down in rate by lowering the temperature. In typical cases the rate is halved by a fall in temperature of 18° F., and vice versa, is doubled by a corresponding rise in temperature. Fig. 31, for example, shows the relation between temperature and the rate of production of carbon dioxide by apples over the range of 30° F. to 80° F. It is therefore only to be expected that the storage life of fruit will depend largely upon the temperature at which it is stored, and that by reducing the temperature not only will the ripening changes in the fruit be retarded, but also the rate of growth of the moulds which cause rotting of the fruit. A difference of not more than 1° F. in the average temperature during storage may make a significant difference in the storage life of the fruit. This fact was brought out in an interesting way in an experiment carried out by the Food Investigation Board in the season 1925–26, when part of the crop from a single orchard was distributed among a number of unrefrigerated fruit stores in various parts of the country, the experimental fruit

being placed amongst the other fruit in the store. Records of the temperature and humidity of the air in each of the stores were obtained throughout the experiment. After about four and a half months' storage, obvious differences in the extent of yellowing and wastage of the experimental fruit were observed. The greenest and least

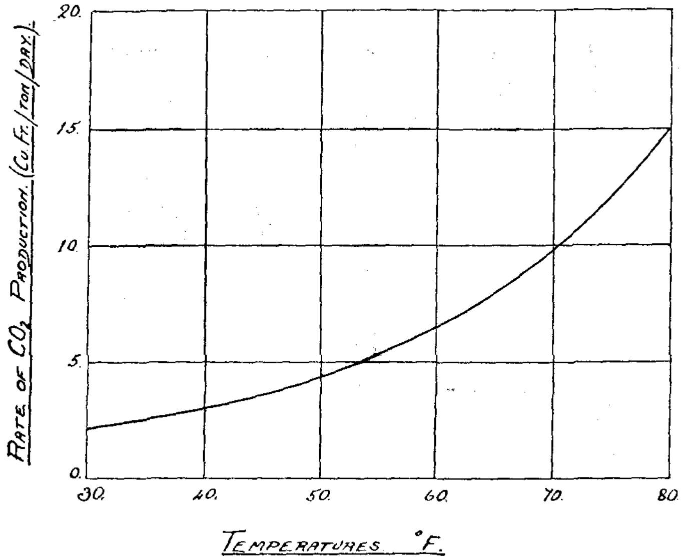

FIG. 31.—RELATION BETWEEN TEMPERATURE AND THE RATE OF PRODUCTION OF CARBON DIOXIDE IN APPLES.

wasty fruit was taken from the store in which the lowest average temperature had been maintained, whereas the most wastage was observed amongst the fruit taken from the store with the highest average temperature. In Table I data are presented which illustrate this point.

TABLE I.

Relation of Temperature to Storage Life of Apples.

Type of store.	Average temperature of store throughout storage period.	Relative humidity of store.	Percentage of 'Bramley's Seedling' apples sound on March 3, 1926.
	° F.	%	
Barn store near Norwich.	41·4	95	57
"Ventilated" store near Wisbech . . .	41·8	95	39
Underground concrete-lined store at Chelmsford	42·0	95	42
Semi-insulated store at Cambridge . . .	43·0	95	29
"Ventilated" store at Little Bognor, Sussex .	44·2	95	18

The profound effect upon the keeping quality of apples of quite small differences in average temperature of storage was emphasized by the results obtained from the large-scale experiment at the Ditton Laboratory in which about 130 tons of 'Bramley's Seedling' apples were stored under conditions which were very accurately determined throughout the experiment. By means of 200 electric thermometers, which were distributed amongst the fruit, the temperature of the fruit was recorded every four hours during a storage period of approximately six months. At the end of this period a number of boxes of fruit from the coolest parts of the store and a corresponding number of boxes from the warmest parts of the store were examined for wastage, and the sound fruit was then removed to a constant temperature room at 15° C., where it was kept under observation. A brief summary of the results obtained are presented in Table II.

TABLE II.

Effects of Small Differences in Temperature in the Cold Storage of Apples.

Season.	Date of examination.	Period of storage (weeks)	Average flesh temperature of fruit during storage.	Wastage on removal from store.	Ground-colour on removal from store.	Wastage during "distribution" period of two weeks at room temperature (60° F. approx.) after removal from cold store.	Cause of wastage.
			° F.	%		%	
1930–31	8.4.31	20	37·2	36	Green to yellowish-green	7	Fungal rotting
			38·9	3	Yellowish-green to yellow	17	Fungal rotting
1931–32	13.4.32	27	37·4	36	Predominantly green	Not determined	Low-temperature breakdown
			37·9	6	Green and yellow equal	Not determined	Low-temperature breakdown
			38·9	1·5	Predominantly yellow	Not determined	Low-temperature breakdown
1932–33	26.4.33	29	37·5	3	—	27	Fungal rotting
			39·0	7	—	39	Fungal rotting

The widespread use of mechanical refrigeration in the storage of fruit has brought into clear view a serious limiting factor in its application, namely, that for all kinds of fruit, including apples, there exists a low-temperature limit of tolerance which is well above the actual freezing point of the tissues. When stored below this limit of temperature for any considerable time various types of low-temperature injury are induced in the fruit. In apples this injury, which takes the form of browning of the flesh, is known as low-temperature breakdown, and may become obvious only after the removal of the fruits to ordinary temperatures. It is evident therefore that the best temperature for cold storage is that which is low enough to obtain maximum retardation of ripening, but sufficiently high to avoid wastage from low-temperature breakdown.

Curves A, B and C of fig. 32 depict the relation between temperatures and storage life of three varieties of apples characterized by different degrees of susceptibility to low-temperature breakdown. Curve A represents the relation for a very resistant variety, namely the 'Newton Wonder,' the storage life of which may progressively increase with fall of temperature almost to the freezing point. Curve B shows the relation for the 'Bramley's Seedling,' a susceptible variety, and Curve C that for a very susceptible variety, namely the 'King of the

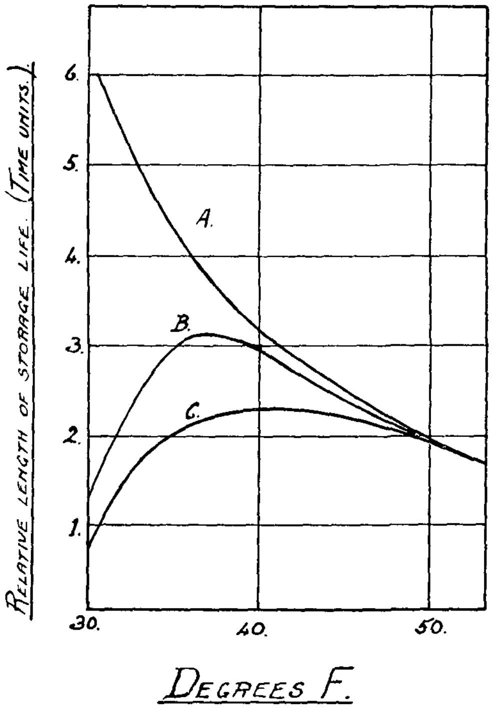

FIG. 32.—RELATION BETWEEN STORAGE LIFE AND TEMPERATURE OF STORE.

Pippins.' Such diverse factors as climate, cultural conditions, maturity at picking, and especially the maturity of the fruit when it is cooled down, play a part in determining the limit of low temperature which apples will tolerate.

An experiment which shows that the development of low-temperature breakdown in cold storage is a function of the stage of maturity of the fruit at the time of cooling is sufficiently interesting to justify a brief description. 'Bramley's Seedling' apples were used; samples, each consisting of 200 carefully selected fruits, were stored at 50° F. in single layers in trays immediately after gathering. Samples were removed to 34° F. at successive intervals. The respiratory activity (carbon-dioxide production) of one sample was followed at 50° F. from the time of gathering onwards in order to ascertain the

physiological age of the fruit at the various dates when samples were transferred to cold storage.

Curve A in fig. 33 depicts the course of respiratory activity at 50° F. of these apples. The characteristic rise in activity, which is known as the climacteric, commenced after 10 days' storage, and reached its maximum after 20 to 30 days. The dotted line B connects points which give the values for the percentage of breakdown in the apples which had been removed to 34° F. at these points, when examined after prolonged cold storage. A striking parallelism is shown between the onset of low-temperature breakdown in cold storage and the state of the fruit with regard to the climacteric rise

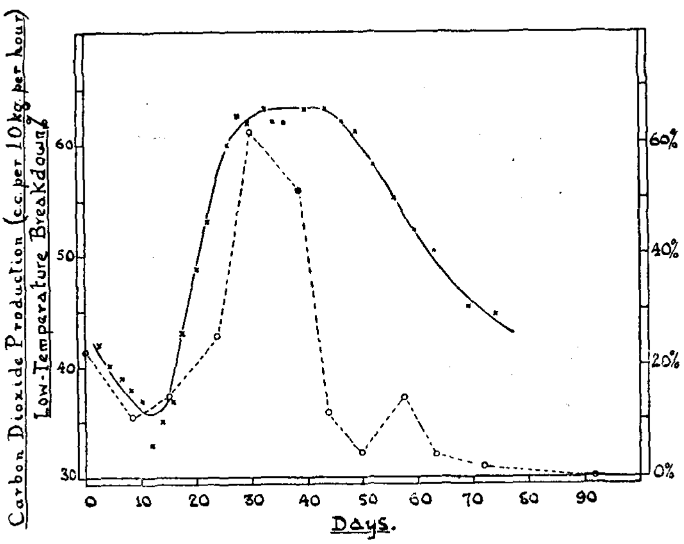

FIG. 33.—RELATION BETWEEN DEVELOPMENT OF LOW-TEMPERATURE BREAKDOWN IN 'BRAMLEY'S SEEDLING' APPLE IN COLD STORAGE, AND DEGREE OF MATURITY OF FRUIT WHEN IT IS COOLED DOWN.

in respiratory activity at the time of cooling. In other words, the flesh tissues of the apple break down more quickly when the fruit is cold-stored at the peak of the climacteric than they do before or after this stage.

(b) *Humidity of the Storage Atmosphere.*—The evaporation of water from the fruit tends to raise the humidity of the storage atmosphere to an equilibrium value which is a function of the rate of evaporation, the rate of heat production, the rate of air movement and other factors. Dr. A. J. Smith has recently shown that on theoretical grounds an equilibrium value of from 92 per cent. to 95 per cent. relative humidity should be expected in a commercial apple store completely filled with fruit. Actual determinations of the relative humidity of the air in various types of stores filled with fruit, as for example those to which reference has been made above, lend support to Dr. Smith's hypothesis. It can be assumed, therefore,

that under normal conditions, either in a natural store or in a refrigerated store full of apples, the relative humidity of the air will be in the neighbourhood of 92 per cent. to 95 per cent. This humidity is, for all practical purposes, a satisfactory one for the storage of apples.

(c) *Composition of the Storage Atmosphere.*—Since there is a definite limit to the temperature which can be used for long-period storage of many of the most valuable varieties of apples, control of the composition of the storage atmosphere is now being adopted as an additional means of retarding the ripening of the fruit. The method in which atmospheric control is used as an auxiliary to cold storage is now generally known as gas storage. It should be emphasized, however, that gas storage is an improved form of cold storage. The temperature must be regulated and mechanical refrigeration employed, even if for no other reason than to counteract the self-heating of the fruit when stored in bulk.

As pointed out above, fruit in the living state breathes like an animal, and in doing so consumes oxygen and gives out carbon dioxide in practically equal volumes. It follows therefore that if apples are stored in a gas-tight chamber they will bring about a rise in the percentage of the carbon dioxide and a corresponding decrease in the percentage of oxygen in the storage atmosphere. These changes in the composition of the atmosphere retard the respiratory and other physiological processes of living plants and plant organs, including the germination and growth of rot-producing fungi. In the gas-storage method of storing apples advantage has been taken of this knowledge, atmospheres of regulated composition, both as regards oxygen and carbon dioxide content, being obtained and maintained by rendering the store more or less gas-tight and regulating the admission of fresh air.* In Table III some particulars are given of temperature and composition of the storage atmosphere, which have been found to be safe for certain varieties of apples.

It will be observed that whereas for the 'Bramley's Seedling,' our most important culinary apple, and for a few other varieties the best storage conditions can be obtained by the simple method of controlled ventilation which is at present in commercial use, the low concentrations of both oxygen and carbon dioxide required by other varieties cannot be obtained by ventilation alone. Tests on a commercial method of obtaining such conditions are now being carried out at the Ditton Laboratory. The method consists essentially of a liquid circuit which absorbs carbon dioxide from the atmosphere inside the store and parts with it to the outside air.

Apart from its remarkable capacity for prolonging the storage life of the fruit, gas storage to an even greater degree retards the change in ground colour from green to yellow—a point of great

* High concentrations of carbon dioxide (12 to 15 per cent. and over) may have an injurious effect upon apples (*i.e.*, brownheart), while in the complete absence of oxygen the fruit is quickly asphyxiated.

importance in culinary varieties. Apples removed in May from gas storage to air at ordinary temperatures have remained in excellent

TABLE III.

Temperatures and Atmospheres Recommended for the Storage of Home-grown Apples.

Variety.	Storage temperature * °F.	Storage atmosphere.	
		CO_2 %	O_2 %
Culinary Varieties :			
'Annie Elizabeth' . . .	34 to 35	0	21 (natural air)
'Bramley's Seedling' . .	40	8 to 10	13 to 11 †
'King Edward VII' . .	37 to 40	5 to 10	2·5
'Lane's Prince Albert' . .	39 to 40	5	2·5 to 5
'Lord Derby'	40	8 to 10	13 to 11 †
'Monarch'	34	5	2·5 to 5
'Newton Wonder' . .	34	0	21 (natural air)
'Stirling Castle' . . .	40	8 to 10	13 to 11 †
Dessert Varieties :			
'Blenheim Orange' . .	37 to 38	0	21 (natural air)
'Cox's Orange Pippin' . .	39 to 40	5	2·5
'Ellison's Orange' . .	34	5	2·5 to 5
'King of the Pippins' . .	39 to 40	0	21 (natural air)
'Laxton's Superb' . .	40	10	2·5
'Worcester Pearmain' . .	34 to 35	5	2·5 to 5

condition for a further six weeks. An additional advantage of gas storage over cold storage in air is that it provides almost complete control of injury due to surface-eating Tortrix larvae.

* Temperature of the flesh of the apple.

† These atmospheres are obtainable by the simple method of controlled ventilation, as now practised in the commercial gas-storage of apples (see Food Investigation Board, Special Report No. 30, London, 1927).

GATHERING AND STORING OF APPLES AND PEARS.*

By E. NEAL.

THE fruit room should be put in order before any fruit is collected. The walls should be given a coat of limewash and the shelves thoroughly washed down. All rubbish should be removed from the floor and then some clean straw put down. The straw will save any fruits that may be dropped from getting badly bruised. The floor itself should preferably be well-beaten earth. Leave all ventilators and inside doors open: the outside doors should have panels of perforated zinc, the mesh being small enough to exclude wasps.

The gathering of apples commences with the early varieties such as 'Irish Peach,' 'Beauty of Bath,' 'Maidstone Favourite,' 'St. Everard's Pippin,' 'Laxton's Exquisite,' 'St. Edmund's Pippin,' 'Early Victoria,' 'Lord Grosvenor' and some of the Codlins. Many of these varieties are taken straight from the tree to the kitchen or table about the end of August or early in September. Some of the fruits may be left on the trees for picking for storage, but on the whole it is unwise to store the very early varieties. The fruits that are not used in the house should be disposed of as quickly as possible.

The very early varieties are followed by others such as 'James Grieve,' 'Lord Lambourne,' 'Stirling Castle' and 'Warner's King.' These should be gathered as they become ready and brought into the fruit room for storing. Each individual fruit should be examined so that only sound fruits are actually packed on the shelves. Defective fruits must never be stored as they may sooner or later contaminate the adjoining fruits. It is advisable to pack these second early varieties as near to the door as possible as they will be the first to remove for use.

The mid-season varieties follow close on the heels of the second earlies, and include the bulk of the varieties usually grown. They should be picked as they become ready, but it is not necessary to clear each tree at one picking. If the fruits that are not quite ready are left for a few days, the period in which the variety is at its best is slightly prolonged, an important point for dessert kinds.

The fruits must be carefully examined and only sound fruits stored. It is advisable to grade the fruit when gathering, separate baskets being kept for first, second and third grades. This grading will save a great deal of time and trouble when placing the fruit on the shelves. Each grade should be kept by itself on the shelves.

The fruits can be piled on the shelves to a considerable height, *i.e.* five or six layers deep. The actual number of layers depends on the size of the crop and the room available for storing.

* Prepared for but not read at the Conference.

Finally, there are the latest varieties, such as 'Bramley's Seedling,' 'Crawley Beauty,' 'Ontario,' 'Edward VII,' 'Court Pendu Plat' and 'Lord Hindlip.' In ordinary seasons these will often not be ready to pick until well into November. If these late varieties are picked too soon in a normal season they are more apt to shrivel than when left to the last minute.

There is no hard and fast rule to say which variety should be gathered first. In the autumn of 1933 many mid-season sorts were quite ready to gather early in September, *e.g.* 'Royal Jubilee,' 'Lane's Prince Albert' and others. Some of the late varieties were gathered and stored by the end of September. Though gathered so early these varieties kept just as well as in a normal season. Some 'Cox's Orange Pippin' picked early in September were of excellent quality when ready for use. Even the very latest sorts which were stored in the middle of October, *i.e.* three weeks earlier than usual, kept well to the end of May 1934.

If the best results are to be obtained, the gathering from the trees must be done carefully. If the apple is slightly reversed, it should leave the spur readily when ready for picking. If the apple is twisted off, it may part from the stalk and will not keep so long when stored, and damage may be done to the buds that are required for another year.

If there is any doubt as to the readiness of any variety, a few fruits can be picked and cut open to see if the pips are brown or black. If they are so coloured, the variety is probably in the right condition for gathering. This guide is not always absolutely correct, but it is a fairly good rough test of condition.

If the fruits get wet when gathering, it is advisable to leave them in some dry, open shed until quite dry. Do not pile wet fruit on the shelves.

If the fruit room is built on the north side of a wall, the temperature will keep very even throughout the winter. It is not necessary to close the inner doors or ventilators, though some growers get equally good results by so doing. With free ventilation the very late sorts keep quite well into June.

If it is desired to keep some of the best dessert fruit for use in the late winter and early spring, a number of the best fruits should be picked out, carefully examined for condition, wrapped in the properly prepared grease paper and packed in boxes. These boxes can be kept on the earth floor of the fruit room, or placed in a cellar in the house. Such apples as 'Lord Hindlip,' 'Court Pendu Plat' and 'Claygate Pearmain' treated in this manner will keep well till April or even early May.

After the apples have been gathered and stored, a careful watch must be kept on them throughout the time they are in the fruit room. Even if the greatest care has been taken in gathering and storing it is still necessary to overhaul periodically every shelf in the room. Such work can easily be done on wet days if the light is good. By taking

a little trouble it is not difficult to have good cooking varieties such as 'Ontario,' 'Edward VII' and 'Crawley Beauty' in first-class condition at the end of May.

It is not absolutely necessary to have a specially built fruit room, though the best results will be obtained from a properly designed and constructed store. Care in gathering, proper examination of each fruit before storing and periodical inspection of the stored fruits are quite as important as the actual building.

Gathering and Storing of Pears

The pears can be stored in the same room as the apples if necessary, but as they require a little more warmth than apples it is better to store them in a separate place if available. It is then easier to get them into the best condition for eating.

Most pears are improved in flavour if gathered some days or even weeks before they are ripe. Such a pear as 'Williams' Bon Chrétien' develops its flavour much better if laid out in a dry and airy room till ready for eating. The second earlies such as 'Beurré d'Amanlis,' 'Beurré Superfin' and many others may be gathered and treated in the same way.

The mid-season varieties, of which 'Doyenné du Comice' is the best of all, may be had in the best of condition over a long period by means of successional picking.

Some of the fruits should be gathered in the second week of October, some more ten days later, and the final picking can be made in the first week of November. With such a fine pear as 'Doyenné du Comice' the extra trouble is well worth taking. There are many other varieties that should be gathered in the same way if a succession of fruit in the best condition is required.

The very late varieties include 'Josephine de Malines,' 'Glou Morceau' and 'Duchess of Bordeaux.' These will often hang on the trees well into November, but it is not always wise to let them remain out after the first week in November. Successional pickings should be made as with the mid-season sorts.

All pears should be most carefully handled when being gathered and conveyed to the fruit room. Flat boxes or crates with a layer of wood wool at the bottom should be used and the fruits laid singly on the wood wool. It is essential to avoid bruising the fruit. The fruits must be laid out singly on the shelves and not piled up as with apples. The very latest varieties may be packed fairly close for a time if space is limited. Free circulation of air should be maintained until the days get to their shortest, when it will be necessary to keep the room a little closer and warmer.

As with apples a periodical inspection of the fruit is essential, and all fruits showing the smallest sign of deterioration must be thrown away.

EXHIBITION OF APPLES.

In conjunction with the Conference and in addition to the great collection of Apples, Pears and other fruits exhibited under the schedule of the Annual Fruit Show held by the Society, an endeavour was made to collect together as many of the varieties of Apples now grown in this country as possible. Our grateful thanks are due to a large number of persons (whose names are given below, p. 182) who went to much trouble to secure local and uncommon varieties and to make the exhibition as complete as possible. A list of the varieties shown, with notes upon them, is given on pp. 185 to 203. In addition to the Apples for cooking and dessert a comprehensive collection of cider varieties was also exhibited, collected and arranged by Professor B. T. P. Barker, of the Long Ashton Fruit Experiment Station, and a list of these will be found on pp. 204 to 208.

Several foreign correspondents also contributed varieties to the exhibition and upon these a note is printed on p. 209, from Mr. E. A. Bunyard. A list of Apples received from various countries abroad is printed on p. 209.

General Notes.

Six fruits of each variety, with foliage, were staged, and in many instances the variety was shown from two or more different parts of the country for comparison, and to demonstrate variations of colour, etc., which might be attributed to locality and soil.

As was to be expected with such a large number of varieties brought together at one time, the specimens of early and late varieties were often out of character, due to premature harvesting, or storage long past their normal season. Certain of the early varieties were kept in cold store for some weeks previous to the exhibition, and their collapse shortly after staging was inevitable.

Several varieties promised by collectors were not available, and in some instances only foliage was sent and the names of these are not included in the lists. Numerous varieties were staged as " unknown "; comparatively few of these were identified and most must be regarded as " local seedlings " without name.

There is, it appears, some confusion as to the true ' Yorkshire Beauty ' Apple. It is interesting to note that Hogg describes ' Greenup's Pippin ' and recognizes ' Yorkshire Beauty ' as a synonym, and lists as additional synonyms ' Cumberland Favourite,' ' Red Hawthornden ' and ' Counsellor ' ; whereas other authorities describe ' Yorkshire Beauty ' and record ' Greenup's Pippin ' as a synonym. In this collection there were seven boxes of fruit staged under the name ' Yorkshire Beauty ' from Cumberland and from Hereford ; ' Greenup's Pippin ' from Yorkshire, ' Greenolph's Pippin ' from

Cumberland, and 'Rolland Green' and 'Red Hawthornden' from Surrey. These represented two distinct varieties. The specimens of 'Yorkshire Beauty' and 'Greenolph's Pippin' were alike in fruit and foliage and distinct from the others, all of which were regarded as representing the true 'Yorkshire Beauty.' In colouring the two forms are much alike, except that the red flush on the Cumberland specimens is mostly round the apex of the fruit, while with the true 'Yorkshire Beauty' the flush is mainly on the side and rarely extending to the eye of the fruit. The true 'Yorkshire Beauty' is round and only slightly ribbed and the eye is half open in a wide, round and rather deep, slightly plaited basin; whereas the fruit of 'Yorkshire Beauty' and 'Greenolph's Pippin' from Cumberland taper markedly to the eye, which is closed and set in a very shallow and much plaited basin. Apparently these two types have long been recognized by observers and a possible explanation is that stocks were confused when the variety was introduced about the end of last century.

HOGG describes 'Dr. Harvey' and 'Waltham Abbey' as distinct varieties, but BUNYARD recognizes 'Dr. Harvey' as a synonym of 'Waltham Abbey.' Specimens of 'Waltham Abbey' were staged from Surrey and Cumberland, and of 'Dr. Harvey' from Surrey, and the specimens proved identical. The 'Dr. Harvey' (Harvey Apple) described by HOGG was not represented in the collection, but another variety labelled 'Dr. Harvey,' syn. 'Waltham Abbey,' was identified as 'Golden Noble,' which is quite distinct.

HOGG records 'Nelson's Glory' as a synonym of 'Warner's King,' but the fruit of 'Nelson's Glory,' staged from Dundee, was distinct in fruit and foliage. Also the fruit of 'D. T. Fish,' sent by BUNYARD, and which is recorded as a synonym of 'Warner's King,' represents a distinct variety—the fruit of 'D. T. Fish' being distinguished by deep golden colouring, and oblong or ovate form much flattened at base and apex; and by the numerous white dots scattered over the skin and the short, knobbed stalk set in a deep broad cavity.

'Gloria Mundi' was staged under BUNYARD'S correct name from Surrey and as 'Monstrous Pippin' from Cornwall. The 'Belle du Bois' HOGG records as a synonym of 'Gloria Mundi' was staged from Surrey and the fruits confirmed BUNYARD'S record that it is a distinct variety. The distinction is not apparent from an external examination of the fruit. The main differences are:

Variety.	Habit of Growth	Tube.
'Gloria Mundi' .	Upright.	Conical, medium to shallow; broad.
'Belle du Bois' .	Spreading.	Funnel-shape, deep, narrow.

The varieties 'Mère de Ménage' and 'Flanders Pippin' and their synonyms are often confused. In this group there was staged 'Mère de Ménage' from Surrey, 'Harlow Pippin' from Surrey, 'Winter

Colmar' from Kent, 'Flanders Pippin' from Herefordshire, and 'Sweet Cleave' from Devon. HOGG describes 'Mère de Ménage' and recognizes 'Flanders Pippin' as a synonym and also describes it as a distinct variety. BUNYARD records them as distinct varieties, and this is confirmed. Examination of the specimens show 'Harlow Pippin' and 'Winter Colmar' to be synonyms of 'Mère de Ménage,' and 'Sweet Cleave' to be a synonym of 'Flanders Pippin.' In form and colouring the varieties closely resemble each other, but the fruit of 'Flanders Pippin' are rarely as large as 'Mère de Ménage,' and the foliage is distinct. But the most marked distinction may lie in the arrangement of sepals in the eye of the fruits. The eye is closed in both varieties, but while the sepals of 'Mère de Ménage' are nearly flat and stand apart, the sepals of 'Flanders Pippin' are closely packed and stand rather erect.

Two distinct varieties were staged under the name of 'Ashmead's Kernel.' That from Gloucestershire is regarded as representing the true variety and the other from Surrey was identified as 'Ross Nonpareil,' with which, apparently, the true 'Ashmead's Kernel' is often confused. In form and colouring there may sometimes be close resemblance, although 'Ross Nonpareil' is usually round and regular in form, whilst 'Ashmead's Kernel' is a slightly taller and more angular fruit. They may be readily distinguished by the eye and by the stem of the fruits.

Variety.	Eye.	Basin.	Stem.	Cavity.
'Ashmead's Kernel'	Closed.	Fairly deep, wide, slightly ribbed.	Medium to long.	Deep, wide.
'Ross Nonpareil' .	Wide open.	Shallow, regular.	Long, slender.	Narrow, deep.

Regarding the Apple 'Tillington Court' (from Mr. C. E. PEARSON of Herefordshire), Mr. H. BARNETT writes :

> " It is an apple I have long known as 'Tillington Court Pippin,' the tradition at Tillington Court being that it was raised there many years ago. There is a Herefordshire Apple named 'Carpenter,' which is said to bear a great resemblance to it, which goes by the name of 'Carpenter' at Dilwyn, a parish six or eight miles off. A resident at Dilwyn was recently calling attention to the fact that some hundred years ago one of the Carpenter family moved from Dilwyn and bought Tillington Court. Hence, in his opinion, arises the synonym. Should it bear its territorial or ancestral title ? "

A variety known as 'The Carpenter' was sent by Mr. A. D. HARRISON, Swansea, but this is distinct from 'Tillington Court,' and in the absence of specimens of the Dilwyn Apple known as 'Carpenter' the question as to the correct name must remain undetermined.

LIST OF PERSONS WHO CONTRIBUTED APPLES TO THE EXHIBITION OF VARIETIES.

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YELD, G., Orleton, Austen Wood Common, Gerrard's Cross, Bucks.

Varieties of Apples Exhibited at the Fruit Conference, 1934.

Abbreviations Used.

Use.

D = dessert.
K = kitchen.

Size.

1 = small.
2 = medium.
3 = large.

Shape.

c. = conical.
o. = oval.
fl. = flat.
r. = round.
irr. = irregular.
sq. = square.
ob. = oblong.
ov. = ovate.

Colour.

y. = yellow.
r. = red.
g. = green.
br. = brown.
flu. = flushed.
rus. = russetted.
str. = striped.

N.B.—*Names in* **thick type** *are of Apples which can be recommended for garden or general cultivation.*

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
Adams' Pearmain	Many	D.	Dec.–Mar.	2	c.	y.r.rus.
Akero (Aakero)	Wisley, N. Ireland	,,	Sept.–Oct.	2	o.c.	y.r.
Aker's Seedling	Oxford	,,	Oct.–Nov.	2	c.	,,
Alabaster	,,	D. or K.	Nov.	3	fl.	r.str.
Alderman	Wisley	K.	Oct.–Nov.	3	c.	g.
Alexander Dean	Berks	,,	Sept.	2	r.	y.
Alfriston	Many	,,	Dec.–April	3	r.fl.	g.
Allen's Everlasting	,,	D.	April–May	2	fl.	r.rus.
Allington Pippin	,,	,,	Oct.–Dec.	2	c.	y.r.
All-spice	Devon	,,	,,	2	r.	y.rus.
American Mother. *See* Mother.						
American Prolific	Long Ashton	K.	—	2	r.	g.
Ames	Wisley	D.	Oct.–Nov.	2	c.	r.
Ananas Reinette	Hants	,,	,,	1	r.	y.
Anne Wheatley	Bucks.	K. or D.	Nov.–May	2	c.irr.	y.r.flu.
Annie Elizabeth	Many	K.	Dec.–May	3	c.	r.str.
Antonowka	Estonia	,,	Oct.–Dec.	3	,,	y.
Antrim Lady's Finger	N. Ireland	,,	Nov.–Jan.	2	c.irr.	y.r.flu.
Archimedes	Lancs.	,,	Oct.–Nov.	3	c.	g.
Aromatic Russet	Many	D.	Dec.–Feb.	2	,,	r.rus.
Arthur Sheen. *See* Autumn Pearmain.						
Arthur Turner	Wisley	K.	Aug.–Nov.	3	c.r.	g.y.
Ascot	,,	D.	Sept.	2	r.	r.str.
Ashmead's Kernel	Gloucester	,,	Dec.–Mar.	2	r.sq.	br.rus.
Astrachan (large fruited)	Wisley	D.	Aug.–Sept.	3	c.	r.
Astrachan Red	,,	,,	,,	2	,,	,,
Autumn Harvest	Cumberland	—	—	—	—	—
Autumn Pearmain	Many	D. or K.	October	2	c.	y.rus.flu.
Autumn Rouge	Kent	K.	Sept.	2	r.	y.str.
A. W. Barnes	Wisley	D. or K.	Oct.–Nov.	3	,,	,,

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
Bachelor's Glory. *See* Hoary Morning.						
Baddow Pippin. *See* D'Arcy Spice.						
Baldwin	Wisley	D.	Oct.–Nov.	2	r.	r.str.
Ball's Pippin	"	"	Dec.–Mar.	3	fl.	g.rus.
Ballyfatten	N. Ireland	K.	—	3	ob.	y.str.
Barnack Beauty	Many	D. or K.	Dec.–Mar.	2	ov.	r.str.
Barnack Orange	Wisley	D.	Oct.–Dec.	2	r.	y.r.str.
Barnhill Pippin	N. Ireland	"	—	2	fl.	r.
Baron Wolseley. *See* Dewdney's Seedling.						
Barton Pippin	Herts.	D. or K.	Jan.–Mar.	2	r.c.	y.r.flu.str.
Bascombe Mystery	East Malling	K.	—	2	c.	g.
Baumann's Reinette	Many	D. or K.	Dec.–Jan.	2	r.	r.
Baxter's Pearmain	Kent, Herts.	"	Dec.–Feb.	2	c.	y.str.
Bazeley, The	Bucks.	"	Sept.–Dec.	2	"	g.y.rus.
Beauty of Bath	Wisley	D.	August	2	r.fl.	r.str.
Beauty of Bedford	Bedford	"	Sept.	2	r.c.	y.r.str.flu.
Beauty of Hants	Wisley	"	Dec.–Feb.	3	c.	y.str.
Beauty of Kent	Many	K.	Dec.–Mar.	3	"	"
Beauty of Stoke	"	D. or K.	Jan.–Mar.	2	r.	g.flu.
Beauty of Waltham	Sussex	D.	Sept.–Oct.	2	c.	g.y.r.str.
Bedford Pippin	Bedford	"	Sept.	2	"	r.str.
Bedfordshire Foundling	Wisley	K.	Jan.–Mar.	3	ov.sq.	y.flu.
Bee Bench	Stafford	"	—	1	c.	g.
Beeley Pippin	Wisley	D.	Oct.	2	r.	r.str.
Belle Bonne	Herefordshire	K.	Oct.–Jan.	3	r.irr.	g.flu.
Belle de Boskoop (*syn.* Reinette Monstreuse)	Many	D. or K.	Dec.–April	3	r.ov.	y.r.flu.rus.
Belle de Pontoise	"	K.	Dec.–Feb.	3	fl.	g.str.
Belle du Bois	Wisley	K.	Nov.–Jan.	3	c.irr.	g.y.
Ben's Red	Many	D.	Sept.	2	"	r.
Benoni	"	"	"	2	r.c.	y.r.str.flu.
Bess Pool	Sussex	D. or K.	Nov.–Mar.	2	c.	r.str.
Betsy Baker	Stafford	K.	—	1	"	g.
Best in England	Lincs.	"	—	2	c.irr.	g.r.str.flu.
Betty Geeson	Many	"	Jan.–Mar.	2	fl.	g.y.
Bielo Borodawka	Wisley	D. or K.	Sept.	3	r.	y.str.
Birkin	"	K.	—	2	r.c.	g.r.str.
Bismarck	Many	"	Nov.–Feb.	3	c.	r.str.
Black Annette	N. Ireland	D. or K.	Nov.–Jan.	2	ov.	r.
Black Jack	E. Sussex	K.	—	2	r.fl.	d.r.
Black Twig	Herefordshire	D.	Jan.	1	fl.	g.
Blacksmith	"	K.	Oct.	3	"	g.flu.
Blenheim Orange	Many	D. or K.	Nov.–Jan.	3	r.	g.r.rus.
Blood of the Boyne	Reading	"	Dec.–Jan.	2	r.fl.	r.
Blue Pearmain	Wisley	"	Nov.–Jan.	3	r.	r.str.
Bodil Neergaard	"	D.	Dec.–Jan.	2	ov.c.	y.-r.
Boddnergard	—	—	—	—	—	—
Bodenham Beauty	S. Wales	D.	—	3	r.	g.flu.
Bossom	Surrey	"	Dec.–Jan.	2	c.	g.rus.r.flu.
Boston Russet	Kent	"	Jan.–Mar.	2	r.	b.g.rus.
Bowden Harrier	Devon	"	Dec.–Mar.	3	r.irr.	y.r.str.
Bow Hill Pippin	Wisley, Reading	"	Nov.–Feb.	2	r.	y.str.
Bradbury	Suffolk	K.	—	2	"	g.br.str.
Braddick's Nonpareil	Many	D.	Nov.–April	1	r.fl.	g.y.flu.rus.

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
Bramley's Seedling.	Many	K.	Nov.–Mar.	3	r.	g.str.
Bramley's Seedling Red. *See* Crimson Bramley.						
Brandy Apple	Lincs.	D.	Dec.–May	2	c.	br.r.rus.
Bridget	East Malling	,,	Nov.–Dec.	3	r.irr.	y.r. flu.
Brithmawr	S. Wales	K.	Oct.–Dec.	3	c.irr.	str.r.
British Columbia	East Malling	,,	—	2	fl.	g.
British Queen	S. Wales	D. or K.	Dec.–Mar.	2	r.c.	y.r.str.flu.
Broad Oak	Herefordshire	K.	Nov.–Jan.	2	r.	g.str.
Broadeye	Kent	,,	—	2	c.	y.g.rus.
Broad-eyed Pippin	Surrey	,,	Sept.–Jan.	2	r.	g.str.
Brook's Seedling	I. of W.	D.	—	2	c.	g.y.str.
Brown Eye	Oxford	K.	—	2	r.irr.	g.r.str.
Brownlee's Russet	Many	D.	Jan.–April	2	r.	g.b.rus.
Buff Coat Russet	Cornwall	K.	Dec.–Mar.	3	c.	y.g.rus.
Burgess Seedling	E. Malling	,,	Dec.–May	2	c.irr.	g.br.flu.
Burr Knot	Lincs., Staffs.	,,	Oct.–Nov.	3	r.	y.flu.
Burton Lemon	Yorks.	—	—	2	,,	y.flu.rus.
Buscombe's Fair Maid	S. Wales	K.	Oct.–Nov.	2	,,	str.r.
Bushey Grove	Many	,,	Oct.–Jan.	3	c.	r.str.
Buttery D'Or	Dorset	—	—	—	—	—
Buxted Favourite	Sussex	K.	Dec.–Feb.	2	r.	y.str.
Byfield Beauty	Northants	D.	—	1	c.	,,
Byford Wonder	Wisley, Reading	K.	Nov.–Jan.	3	r.fl.	y.rus.
Bygholmseable	Kent	—	—	—	—	—
Calville Blanche d'Hiver	Wisley	D. or K.	Jan.–April	2	r.irr.	p.y.
Calville Boisbunel	,,	K.	Nov.–Jan.	3	r.c.irr	g.y.r.str.
Calville de St. Sauveur	N. Ireland	,,	Oct.–Dec.	3	r.fl.	y.r.flu.
Calville des Femmes	Wisley	,,	Late June	3	r.irr.	y.flu.
Calville Malingre	,,	,,	Dec.–Mar.	2	r.	y.r.flu.str.
Calville Rouge d'Hiver	Kent	,,	Nov.–Dec.	3	ob.	flu.r.
Calville Rouge Précoce. *See* Reinette Rouge Etoilée.						
Cambusnethan Pippin	Wisley	D. or K.	Oct.–Dec.	2	r.	y.r.str.
Camelot	Long Ashton	K.	—	3	c.	,,
Cardross Green	Kent	,,	Oct.–Dec.	2	r.	g.
Carlisle Codlin	Wisley	,,	Aug.–Nov.	2	c.	y.str.
Carlton Seedling	Lancs.	K.	Nov.–Dec.	2	r.c.	g.y.str.
Carnation Rose	Herefordshire	D.	—	2	r.	g.r.flu.
Carpenter, The	S. Wales	K.	Sept.	2	,,	g.
Carter's Pearmain	Kent	D.	—	2	r.rib.	g.str.
Castle Major	N. Ireland	K.	Oct.–Nov.	3	c.	y.r.flu.
Catshead (*syn.* Pig's Snout)	Wisley	,,	Oct.–Jan.	3	ob. irr.	p.y.br.flu.
Cellini	Many	,,	Oct.–Nov.	2	r.	y.r.str.
Champagner Reinette	Kent	D.	March	2	r.c.	y.
Channel Beauty	Wisley	,,	Oct.–Dec.	1	c.	y.br.flu.
Chantry Greening	Stafford	K.	Till June	3	ob.	g.br.flu.
Chaplin's Pippin	Kent	—	—	—	—	—
Charles Eyre	Many	D.	Late	—	c.	g.r.flu.
Charles Pearmain	S. Wales	K.	Oct.–Nov.	3	r.ov.	y.r.str.
Charles Ross	Many	D. or K.	Oct.–Dec.	3	r.	y.r.str.
Cheddar Pearmain	Long Ashton	D.	—	2	r.c.	y.r.str.flu.
Chelmsford Wonder	Wisley, Reading	K.	Nov.–Mar.	3	r.	,,

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
China Square	Cumberland	D. or K.	Dec.–Feb.	2	c.ang.	y.r.
Christie Manson	Wisley	K.	Oct.–Dec.	3	r.	g.r.flu.
Christmas Pearmain	Many	D.	Nov.–Dec.	2	ov.	y.br.flu. r.str.
Church Apple	Yorks	—	—	—	—	—
Cissy Apple	Monmouth	D.	Sept.–Oct.	2	r.ov.	r.flu.str.
Clark's Pippin	Yorks	,,	Dec.–April	1	c.	g.y.rus.
Clarke's Seedling (*syn.* Royal George)	Many	K.	Till March	3	r.	y.flu.str.
Claygate Pearmain	,,	D.	Dec.–Feb.	2	,,	g.r.flu.rus.
Cleopatra	Cambs., E. Malling	,,	Dec.–Mar.	2	c.	y.
Climax	Wisley	,,	Oct.–Nov.	2	,,	r.str.
Cockett's Red	Wisley, I. of Ely	,,	,,	2	r.	r.flu.
Cockington Calville	Kent	,,	Jan.–April	2	c.	y.r.flu.
Cockle's Pippin	Many	,,	Dec.–Mar.	1	,,	g.y.rus.
Cockpit	Lincs.	K.	Nov.–Dec.	2	c.irr.	g.y.r.flu. rus.
Coe's Golden Drop	Herts	D.	Nov.–Mar.	1	c.	g.br.flu.
Coker Seedling	Long Ashton	K.	—	3	r.irr.	g.str.flu.
Colloget Pippin (*syn.* Cornish Giant, Lawry's Cornish Giant	Herefordshire	,,	Oct.	3	,,	y.r.flu.
Colonel Vaughan	Wisley	D. or K.	Nov.–Jan.	2	ob.	y.str.
Colonel Yate	Surrey	K.	Dec.–Feb.	3	r.irr.	g.r.str.
Coloured Grieve	Wisley	D.	Sept.–Oct.	2	c.r.	y.r.flu.
Comrade	Lincs.	K.	Oct.–Dec.	2	r.	y.str.
Cooper's Seedling	E. Malling	,,	—	3	,,	y.flu.
Coos River Beauty	,,	D.	Jan.–Feb.	1	fl.	r.flu.str.
Corby Seedling. *See* Hormead Pearmain.						
Cornish Aromatic	Many	D.	Dec.–Feb.	2	c.r.	y.r.flu.rus.
Cornish Giant. *See* Collget Pippin	Herefordshire	—	—	—	—	—
Cornish Gillyflower	Wisley	D.	Dec.–May	2	c.irr.	g.y.r.rus.
Cornish Queen	Cornwall	D. or K.	Nov.–Jan.	3	,,	str.r.
Coronation	Many	,,	Oct.–Dec.	2	r.	y.r.str.
Corse Hills	Gloucester	K.	Dec.–Jan.	2	c.	y.r.flu.
Cossacks	N. Ireland	—	—	—	—	—
Cottenham Seedling	Wisley	K.	Nov.–Feb.	3	r.	y.str.
Court of Wick	Herts., Lincs.	D.	Dec.–Mar.	1	,,	y.r.flu.
Court Pendu Plat (*syn.* Tyvrestrup)	Many	,,	Till April	1	fl.	g.y.r.flu. rus.
Cox's Orange Pippin	,,	,,	Nov.–Mar.	2	r.	y.r.str.rus.
Cox's Pomona	,,	K. or D.	Oct.–Dec.	3	r.irr.	y.r.flu.str.
Cow's Snout	Yorks.	K.	Late	2	c.irr.	g.y.
Craggie's Seedling	,,	,,	Sept.	2	c.	g.
Crawley Beauty	Wisley, Sussex	,,	Dec.–Feb.	2	r.	g.r.str.
Crawley Reinette	Kent, Sussex	D. or K.	Dec.–Mar.	2	r.ob.	y.r.flu.str.
Credenhill Beauty	Herefordsh.	K.	Sept.–Oct.	2	fl.	r.
Credenhill Pippin	,,	D.	Dec.	1	ov.	,,
Crimson Bramley (*syn.* Red Bramley's Seedling)	Many	K.	Nov.–Mar.	3	r.	r.
Crimson Cox	,,	D.	Nov.–Dec.	2	,,	r.flu.
Crimson King	Long Ashton	,,	Oct.–Nov.	2	c.	y.r.flu.str.

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
Crimson Newton Wonder (*syn.* Red Newton)	Wisley	K.	Nov.–Feb.	3	r.	r.flu.
Crimson Peasgoods	Kent	,,	Sept.–Nov.	3	,,	r.str.flu.
Crimson Queening	,,	D. or K.	Dec.–Feb.	2	c.	g.y.r.flu. str.
Croft Pippin	Staffs.	—	—	2	—	—
Crofton Scarlet (*syn.* Scarlet Crofton)	Wisley	D.	Oct.–Nov.	2	c.	y.r.str.
Cuit	Devon	K.	—	2	,,	g.y.
Cumberland Gilliflower	Cumberland	D.	—	2	c.irr.	y.r.str.
Cutler Grieve	Many	D.	Nov.–Jan.	2	r.	g.y.r.flu.
D'Arcy Spice (*syn.* Baddow Pippin)	,,	,,	Nov.–Apr.	2	r.sq.	g.r.flu.rus.
Delicious	Wisley, Kent	,,	Nov.–Jan.	2	c.irr.	y.r.flu.str.
Devonshire Quarrenden	Wisley	,,	Aug.–Sept.	2	fl.	d.r.
Dewdney's Seedling (*syn.* Baron Wolseley	,,	K.	Dec.–Jan.	3	c.irr.	y.br.flu.
Diamond Jubilee	,,	D. or K.	Dec.–Mar.	3	c.	g.y.
Dr. Clifford	,,	K.	Aug.–Sept.	3	,,	y.
Dr. Harvey. *See* Waltham Abbey.						
Domino (*syn.* Sharleston Pippin)	,,	,,	Sept.–Oct.	2	ob.	y.g.r.flu.
Dorset	Long Ashton	—	—	—	—	—
Downton Pippin	Herefordshire	D.	Nov.–Jan.	1	c.	y.flu.str.r.
Duchess's Favourite (*syn.* Duchess of Gloucester, Red Margaret, Town Apple)	Many	,,	Sept.–Oct.	2	r.	r.
Duchess of Bedford	Wisley	,,	,,	2	,,	y.r.str.
Duchess of Gloucester. *See* Duchess's Favourite.						
Duchess of Oldenburg	Many	D. or K.	Aug.–Sept.	2	,,	y.r.str.
Duke of Devonshire	,,	D.	Jan.–Mar.	2	,,	y.rus.
Dumelow's Seedling (*syn.* Wellington	Kent, Berks.	K.	Till March	2	r.fl.	y.r.flu.
Dutch Mignonne (*syn.* White Dutch Mignonne)	Many	D. or K.	,,	2	r.	y.r.flu.str.
Eady's Magnum	Wisley	K.	Dec.–Feb.	3	ob.	y.str.
Early Julyan	Sussex	D. or K.	Aug.	1	fl.	y.r.flu.
Early McIntosh	Wisley	D.	Aug.–Sept.	2	c.	r.str.flu.
Early Rivers	Herts., Cumberland	K.	Aug.–Sept.	2	r.	y.g.
Early Strawberry	Wisley	D.	Sept.	1	c.	y.r.str.
Early Victoria. *See* Emneth Early.						
Easter Orange	Herts., Kent.	D.	Feb.–April	—	r.	y.r.str.flu. rus.
Eccleston Pippin	Wisley	D. or K.	Oct.–Nov.	2	,,	y.r.flu.
Ecklinville Seedling (*syn.* Prizetaker)	Many	K.	Sept.–Nov.	3	,,	y.g.
Edelborsdörfer	Kent	D.	Jan.–Mar.	1	fl.r.	y.

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
Edith	I. of Wight	K. or D.	Nov.–Dec.	2	r.c.	y.flu.r.
Edith Hopwood	Wisley	D.	Oct.–Nov.	2	r.	y.r.flu.str.
Edmond's Apple	Kent	K.	—	2	r.fl.	g.r.str.
Edward VII	Many	,,	Dec.–April	3	ob.	g.y.br.r. flu.
Egremont Russet	,,	D.	Oct.–Dec.	2	r.	y.br.flu. rus.
Ellison's Orange	,,	,,	Sept.–Oct.	2	c.	y.r.str.flu.
Elmelund	Kent	—	—	—	—	—
Emily Childs. *See* Winter Quarrenden.						
Emneth Early (*syn.* Early Victoria)	—	K.	July–Aug.	2	,,	y.g.
Emperor Alexander (*syn.* Sugar and Cream)	Many	D. or K.	Sept.–Nov.	3	c.r.	y.r.str.
Emperor Napoleon. *See* Reynolds Peach.						
Encore	Many	K.	Till June	3	r.ob.	g.
Endsleigh Beauty	Wisley	D. or K.	Oct.–Dec.	3	r.	y.br.flu. str.
Evagil	,,	,,	Sept.–Oct.	2	fl.	y.g.
Eve Apple	Many	D.	Aug.–Sept.	1	r.c.	y.str.flu.r.
Excelsior	Wisley	D. or K.	Oct.–Nov.	3	r.fl.	g.r.str.
Fall Pippin	E. Malling	K.	Oct.–Dec.	3	r.	y.br.flu.
Farmer Duck	Cornwall	D. or K.	—	2	r.fl.	g.r.flu.str.
Farmer's Seedling	Kent	K.	Till May	3	r.	y.g.r.flu. str.
Fearn's Pippin	Many	D.	Nov.–Mar.	2	fl.	y.r.flu.
Feltham Beauty	Wisley	,,	Aug.–Sept.	2	c.	y.r.flu.str.
Fillbasket	Cheshire	K.	Oct.–Jan.	2	c.irr.	g.y.r.str.
Fillingham Pippin	Wisley	,,	Nov.–Jan.	2	r.c.	,,
Flanders Pippin (*syn.* Sweet Cleave)	Herefordshire	,,	Nov.–Jan.	2	,,	y.r.flu.str.
Fleurville Seedling	N. Ireland	D.	Nov.–Dec.	2	fl.irr.	g.br.r.flu.
Flower of Tenessee	—	—	—	—	—	—
Fordham Wonder	Surrey	D.	—	2	r.	y.r.str.
Forge (*syn.* Sussex Forge)	Sussex, Wisley	,,	Oct.–Jan.	2	r.c.	,,
Foster's Seedling	Kent, Wisley	K.	Nov.–Mar.	2	r.	y.br.flu.
Fraise d'Hoffinger	Wisley	D.	,,	3	,,	y.r.flu.
Francis	,,	,,	Oct.–Nov.	2	,,	y.r.str.flu.
Freminder No. 2	E. Malling	K.	Oct.	2	,,	y.r.flu.
French Crab (*syn.* Winter Greening)	Wisley	,,	Late	2	,,	g.
French Codlin	Surrey	,,	Aug.–Sept.	2	c.	y.r.flu.
Frogmore Prolific	Many	,,	Sept.–Dec.	2	r.	g.y.r.str.
Fugglestone Pippin	Wisley	D.	Oct.–Dec.	2	,,	y.r.str.flu. rus.
Gabalva	Kent, Lincs.	D. or K.	Dec.–Jan.	3	c.	y.r.flu.rus.
Galloway Pippin	Kent, South Wales	K.	Oct.–Feb.	3	r.	y.br.flu.
Garland Longkeeper	Long Ashton	D.	—	1	,,	g.r.flu.
Gascoyne's Scarlet	Many	D. or K.	Sept.–Jan.	3	r.irr.	y.r.str.flu.
Gascoigne's Seedling. *See above.*						
Gennet Moyle	E. Malling	K.	—	2	r.fl.	y.r.str.flu.
George, The	Hants., 92	D. or K.	—	2	c.ob.	y.r.str.flu.
George II	Yorks.	D.	—	2	c.	y.br.r.flu. str.

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
George Carpenter .	Sussex, Wisley	D.	Dec.	3	c.ob.	y.r.flu.str. rus.
George Neal . .	Wisley . .	D. or K.	Sept.–Nov.	3	r.	y.r.str.
Gibby . .	N. Ireland .	D.	Aug.–Sept.	2	c.	g.y.
Gilbey's Seedling .	Cambs. . .	K.	—	2	ov.	g.
Gipsy King . .	E. Malling .	D.	Nov.–Jan.	1	r.fl.	y.r.flu.str. rus.
Gladstone . .	Wisley . .	,,	July–Aug.	2	c.	gy.r.
Glen Favourite, The . .	N. Ireland .	,,	—	2	c.irr.	g.y.
Gloria Mundi (*syn.* Monstrous Pippin, Grosse de St. Clement) .	Wisley, Worcs.	K.	Dec.–Jan.	3	,,	,,
Golden Delicious .	Kent . .	D.	Nov.–Jan.	2	r.c.	y.
Golden Knob .	Kent, Staffs. .	,,	Dec.–May	1	r.fl.	br.r.rus.
Golden Noble .	Many . .	K.	Sept.–Jan.	2	r.	y.
Golden Pearmain *See* Golden Winter Pearmain .	Long Ashton .	—	—	—	—	—
Golden Russet .	Kent, Wisley .	D.	Dec.–Mar.	2	r.	gld.rus.
Golden Spire .	Many . .	K.	Sept.–Dec.	2	ob.c.	gld.y.
Golden Winter Pearmain (*syn.* Golden Pearmain)	Sussex, Surrey	D.	Oct.–Dec.	2	c.	y.r.str.flu.
Golden Wonder .	Long Ashton .	K.	—	2	r.c. irr.	g.
Gondert . .	Staffs. . .	,,	Jan.–Feb.	2	c.	g.y.
Goodwood Pippin	Sussex . .	D. or K.	Nov.–Jan.	2	r.-c. irr.	y.r.str.flu.
Gooseberry . .	E. Malling, Sussex	K.	Nov.–June	2	r.irr.	g.y.br.flu.
Gospatrick .	Herts. . .	,,	Till March	2	r.ob.	g.y.
Gower . .	E. Malling .	D. or K.	—	2	c.	y.r.flu.
Grange's Pearmain	Kent, Somerset	,,	Jan.–May	3	r.	y.r.flu.str.
Granny Smith .	Wisley . .	,,	Nov.–Jan.	2	c.	g.
Grantonian . .	Wisley . .	K.	Jan.–Mar.	2	,,	y.g.br.flu.
Graue Franzosische Reinette . .	Kent . .	D.	,,	3	fl. ang.	rus.
Gravenstein . .	Many . .	D. or K.	Oct.–Dec.	2	r.irr.	y.r.str.flu.
Gravensteiner von Arreskov . .	Wisley . .	,,	Oct.–Nov.	3	,,	y.r.str.
Greasy Coat .	Cheshire .	K.	Dec.–Jan.	2	c.irr.	r.
Greasy Pippin .	Sussex . .	D.	Oct.	2	r.irr.	r.str.
Green Balsam .	Yorks. . .	K.	—	1	r.	g.
Green Bearer .	,, . .	D.	Sept.–Oct.	1	,,	,,
Green Chisel .	,, . .	,,	,,	2	,,	g.y.
Green Fullwood .	Scotland .	—	—	—	—	—
Green Harvey .	Wisbech .	—	—	—	—	—
Green Rolland. *See* Rolland, Green.						
Green Sweet .	Yorks. . .	D.	Aug.–Sept.	2	fl.irr.	g.
Greenup's Pippin. *See* Yorkshire Beauty . .	,,	—	—	—	—	—
Grenadier . .	Many . .	K.	Aug.–Sept.	3,	r.irr.	g.y.
Grimes' Golden .	Wisley . .	D.	Oct.–Nov.	2	c.	,,
Gröningen Kroon	Hants. . .	—	—	—	—	—
Grosse de St. Clement. *See* Gloria Mundi .	Kent	—	—	—	—	—
Guelph . .	Many . .	D.	Oct.–Nov.	2	r.	y.r.flu.str.

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
Gul Corgeable .	Wisley . .	D. or K.	Nov.	2	,,	g.str.
Gull . . .	Cornwall .	D.	Jan.–Mar.	1	ov. ob.	g.br.r.flu.
Gulval Seedling .	,, . .	,,	Oct.–Jan.	2	r.	y.r.flu.str.
Gyllenkrok . .	Wisley . .	—	—	—	—	—
Ham Seedling .	S. Wales .	D. or K.	Oct.–Nov.	3	c.	r.
Hambledon Deux Ans . . .	Wisley . .	K.	Jan.–Aug.	2	c.irr.	y.br.r.flu. str.
Hambling's Seedling . .	Kent, Wisley .	,,	Jan.–Mar.	3	r.	y.
Hanwell Souring .	Many . .	K.	Feb.–April	2	r.	g.y.r.flu.
Harlow Pippin. *See* Mère de Ménage.						
Harvest Lemon .	Cumb. . .	D. or K.	Sept.	2	,,	y.
Harvest Peach .	N. Ireland .	D.	—	3	r.irr.	y.r.str.flu.
Hawthornden .	Wisley . .	K.	Oct.–Dec.	2	r.fl.	y.r.flu.
Hector Macdonald	Hereford, Kent	,,	Oct.–Feb.	2	r.c.	y.g.r.str.
Henry Davies .	Glam. . .	?	?	1	r.	g.r.flu.
Henry Winch .	,, . .	D.	Sept.	—	,,	y.
Hereford Beaufin. *See* next						
Herefordshire Beefing . .	S. Wales, Wisley	K.	Oct.–Jan.	2	,,	g.r.flu.
Herefordshire Pearmain .	Herefordshire	D. or K.	Nov.–Dec.	3	c.irr.	g.y.br.r. str.rus.
Herman's Pippin .	Long Ashton .	D.	—	2	r.fl.	g.br.r.flu. str.
Heusgen's Golden Reinette . .	Kent, Wisley .	D.	Feb.–April	2	r.fl.	y.r.flu.str.
Histon Favourite (*syn.* Chiver's Seedling) . .	—	D. or K.	Nov.–Dec.	2	,,	,,
Hitchin Pippin .	Kent, Wisley .	D.	Aug.–Sept.	2	r.fl.	g.y.r.flu. str.
Hoary Morning (*syn.* Bachelor's Glory) . .	Sussex . .	K.	Oct.–Dec.	2	fl.	y.r.str.
Hodkinson . .	Staffs. . .	,,	—	2	ob.	g.y.r.flu. str.
Holme Apple .	Lincs. . .	,,	Jan.–Mar.	2	r.irr.	g.y.r.
Hollandbury .	Many . .	,,	Nov.–Dec.	3	r.c.	y.r.flu.
Honeycomb .	Glam., N. Ireland	—	—	—	—	—
Hormead Pearmain (*syn.* Corby Seedling) . .	Kent, Wisley .	D. or K.	Nov.–Mar.	3	c.	y.g.br.flu.
Houblon . .	Many . .	D.	Dec.–Jan.	2	r.	y.r.str.rus.
Hounslow Wonder	Glam., Berks.	K.	Dec.–Mar.	2	,,	y.rflu.str.
House of Correction	Northumberland	,,	Dec.–Feb.	2	r.c. irr.	g.
Housewife . .	Cumb. . .	,,	Sept.–Oct.	2	r.	g.y.
Howgate Wonder	Wisley . .	,,	Nov.–Mar.	3	r.irr.	g.
Hume . .	Wisley . .	D.	October	2	r.	y.r.flu.
Hunt's Deux Ans	Surrey . .	,,	Dec.–Mar.	2	ob.c.	g.y.r.flu.
Hunt's Early .	Kent . .	,,	August	2	r.	g.y.r.flu. str,
Hunter's Majestic	Wisley . .	K.	Oct.–Jan.	3	r.irr.	g.r.str.
Improved Cockpit	Yorks . .	,,	Sept.–Jan.	2	ob.c.	y.str.r.
Improved Longbider . .	Devon . .	,,	—	2	c.	y.

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
Ingall's Red	Wisley	D.	Oct.–Nov.	2	r.fl.	y.r.flu.
Irish Canary	N. Ireland	,,	Sept.	2	c.irr.	y.
Irish Johnnies	Edinburgh	K.	,,	2	r.fl.	g.
Irish Molly	,,	D.	Oct.	2	fl.	g.y.str.
Irish Peach	Wisley	,,	Aug.	1	r.fl.	y.str.r.
Jacques Lebel	Herefordshire	K.	Oct.–Dec.	3	fl.r.	g.y.
James Grieve	Many	D.	Sept.–Oct.	2	c.	y.r.str.flu.
James Lawson	Bucks.	,,	,,	2	r.c.	,,
James Sanders	I. of W.	,,	—	2	c.	y.r.str.
Jeanne Hardy	Kent	K.	Nov.–Feb.	3	c.irr.	y.r.flu.str.
Jefferson	,,	—	—	—	—	—
Jeffrey Seedling	Cork	D. or K.	—	2	r.fl.	y.r.str.
Jersey Beauty	Wisley	,,	Oct.–Nov.	2	,,	r.str.flu.
John Apple. *See* Winter Greening.						
John Divers	Surrey	K.	Oct.–Feb.	2	,,	y.r.flu.str.
John Norman	Herefordshire	—	—	—	—	—
John Standish	Many	D.	Dec.–Mar.	2	c.	r.
John Waterer	,,	K.	Oct.–Dec.	3	r.irr.	y.g.
Jolly Beggar	Lincs.	,,	Aug.–Nov.	2	,,	y.r.flu.
Jolly Miller	Norfolk, Cambs.	D.	—	2	r.	g.y.r.flu. str.
Jonathan	89	,,	Nov.–Mar.	2	c.	y.r.flu.
Jordan	92	,,	Sept.–Oct.	2	r.	y.r.str.flu.
Joybells	Many	,,	Oct.–Nov.	2	r.fl.	y.r.flu.str.
Joyce	Wisley	,,	Sept.–Oct.	2	ob.r.	y.r.flu.
Joyce Allardice	,,	K.	Oct.–Dec.	2	r.	g.y.
Jubilee. *See* Royal Jubilee.						
Junetta	Cork	—	—	—	—	—
Keegan's Crab	N. Ireland	—	—	—	—	—
Kemp	,,	D.	Aug.–Nov.	2	r.	y.
Kerl Apple	Glam.	K.	Nov.–Dec.	3	c.	g.
Kerry Pippin	Many	D.	Sept.	2	ov.	y.r.flu.str.
Keswick Codlin	,,	K.	Aug.–Sept.	2	c.	y.r.flu.
Kilkenny Seedling	Cork	D.	Oct.–Nov.	2	r.c.	y.r.str.
King Albert	Wisley	D. or K.	Oct.–Dec.	2	,,	y.r.str.flu.
King Apple. *See* Northern Spy.						
King Coffee	E. Malling	D.	Dec.	3	r.fl.	r.
King David	Surrey	D. or K.	Dec.–Jan.	2	r.	g.
King Edward. *See* Edward VII.						
King Edward VII. *See* Edward VII.						
King George V	Many	D.	Jan.–Mar.	2	,,	y.r.str.
King Harry	Kent	,,	Oct.–Nov.	2	ov.c.	y.rus.
King of the Pippins	Many	,,	Oct.–Dec.	2	ob.	y.br.r.flu. str.
King of Tompkins County	,,	,,	Jan.–April	3	c.irr.	y.r.flu.str.
King's Acre Bountiful	,,	K.	Oct.–Nov.	2	r.	y.g.
King's Acre Pippin (*syn.* Ribston Pearmain)	,,	D.	Jan.–Mar.	2	c.irr.	y.br.r.flu.
Knight's Grange	Sussex	D. or K.	Dec.–Feb.	3	r.fl.	y.r.str.flu.
Labygaard	Denmark	K.	—	3	r.irr.	g.y.r.str.
Lady Henniker	Many	,,	Nov.–Jan.	3	ob.	y.r.flu.str.
Lady Richardson. *See* Golden Noble.						
Lady Seeley	I. of W.	D.	Oct.–Nov.	2	r.	g.y.r.str. flu.

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
Lady Sudeley	Many	D.	Aug.–Sept.	2	c.	y.r.str.
Lady Thornycroft	I. of W.	,,	—	2	r.	,,
Lady's Finger	Kent, N. Ireland	K. Cider	—	2	c.	y.r.flu.
Lake's Kernel	Gloucester	—	—	—	—	—
Lamb Abbey Pearmain	Surrey	D.	Jan.–April	1	ob.	y.r.flu.str.
Lambrook Seedling	Long Ashton	—	—	—	—	—
Landor, Landore	Herefordshire	—	—	—	—	—
Landsberger Reinette	Wisley	D.	Oct.–Jan.	2	r.c.	y.r.flu.
Lane's Oakland Seedling	,,	K.	Oct.–Dec.	3	r.	g.y.rus.
Lane's Prince Albert (*syn.* Prince Albert)	Many	,,	Jan.–Mar.	3	r.c.	g.y.r.str.
Langley Pippin	,,	D.	Aug.–Sept.	2	c.	y.r.flu.str.
Lass O'Gowrie	Scotland	,,	—	2	r.c.	y.r.str.
Lateblower	?	K.	—	1	r.	g.y.
Lawry's Cornish Giant. *See* Colloget Pippin.						
Lawfam	Wisley	D.	Oct.–Nov.	2	r.irr.	g.y.r.str.
Laxton's Early Crimson	,,	,,	July	1	r.	r.
Laxton's Epicure	,,	,,	Sept.	2	,,	y.r.str.flu.
Laxton's Exquisite	,,	,,	,,	2	r.c.	y.r.str.
Laxton's Fortune	Bedford, Herts.	,,	Aug.–Sept.	2	c.	,,
Laxton's Imperial	Bedford, Wisley	,,	Nov.–Jan.	2	r.	y.r.flu.str.
Laxton's Pearmain	,,	,,	Nov.–Dec.	2	c.	g.y.r.str.
Laxton's Superb (*syn.* Superb)	Many	,,	Nov.–Mar.	2	c.r.	g.y.r.flu.
Laxton's Triumph	Bedford, Wisley	,,	Oct.–Dec.	2	r.fl.	g.y.r.str. flu.
Leathercoat	Hants., Staffs.	,,	Nov.–Feb.	2	c.irr.	y.g.rus.
Leather Court. *See* above.						
Lemon Pippin	Hants., Wisley	K.	Jan.–Mar.	2	ov.	y.
Leopold de Rothschild	Wisley	,,	Sept.–Nov.	1	r.	y.r.str.flu.
Lewis' Incomparable	,,	D.	Nov.–Feb.	2	c.	g.y.r.str.
Liddell's Seedling	Cumb.	K.	Oct.–Jan.	2	,,	g.cr.str.
Lincs. Holland Pippin	Lincs.	D.	Nov.–Feb.	2	r.	g.br.r.str.
Livermere Favourite	Wisley	,,	Oct.–Dec.	2	r.fl.	g.r.flu.str.
Livsey's Codlin	Lancs.	K.	—	2	ob.c.	y.r.str.
Lobo	Wisley	D.	Sept.–Nov.	2	r.f.	g.y.r.flu.
Lochinvar	Cumb.	K.	Dec.–Apr.	2	r.	g.
Lock Apple	Herefordshire	,,	—	3	c.	g.y.r.flu.
Lockley's Nonsuch	Staffs.	D.	Oct.–Nov.	2	,,	y.
Loddington. *See* Stone's.						
London Pippin	Lincs.	K.	Till March	2	r.irr.	g.y.br.r. flu.
Long Bider	E. Malling	,,	Late	1	r.fl. irr.	g.
Long Stem	Cornwall	,,	—	2	ob.r.	g.y.
Lord Burghley	Many	D.	Jan.–May	1	r.c.	g.y.br.r. flu.
Lord Derby	,,	K.	Nov.–Dec.	3	ob.c.	g.y.
Lord Duncan	Cumb.	D.	Winter	2	c.	g.y.cr.

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
Lord Hindlip .	Many . .	D.	Jan.–April	2	2	r.flu.str. rus.
Lord Lambourne .	,, . .	,,	Oct.	2	r.	y.r.flu.str.
Lord Kelvin .	I. of W. .	K.	—	2	c.irr.	y.br.r.flu.
Lord Lennox .	Reading .	D.	Sept.	1	c.	g.y.br.r. flu.
Lord Peckover. *See* Astrachan Red.						
Lord Roberts .	I. of W. .	D. or K.	Nov.	2	r.	g.y.r.flu.
Lord Rosebery. *See* Rosebery.						
Lord Stradbroke .	Suffolk, Wisley	K.	Jan.–Feb.	3	r.irr.	,,
Lord Suffield .	Many . .	,,	Aug.–Sept.	2	ov.c.	p.y.
Macey . .	Wisley . .	D. or K.	Sept.–Nov.	2	c.	g.
Macoun . .	,, . .	D.	Oct.–Dec.	2	r.fl.	g.r.flu.
Mabbott's Pearmain . .	Kent, Sussex .	,,	Nov.–Jan.	2	ov.	y.r.flu.
McIntosh Red .	Many . .	,,	Oct.–Dec.	2	r.	r.flu.str.
Madresfield Court	,, . .	,,	Nov.–Jan.	2	c.	g.y.r.flu. rus.
Magdalene . .	Norfolk .	,,	Oct.–Dec.	2	r.	g.y.r.flu. str.
Maggie Grieve .	Cumb. . .	D. or K.	Oct.–Nov.	2	r.irr.	g.y.r.str.
Maglesuary Stribling . .	Wisley . .	K.	Dec.–Feb.	2	,,	,,
Maiden's Blush .	Herefordshire	,,	Sept.–Oct.	3	r.irr.	y.r.flu.
Maidstone Favourite . . .	Many . .	D.	Aug.–Sept.	2	r.fl.	y.r.flu.str.
Malcolm's Delight	Scotland .	,,	—	2	ob.	y.flu.r.
Maltster . .	Cheshire, Kent	D. or K.	Oct.–Jan.	3	r.irr.	g.y.r.flu. str.
Mank's Codlin .	Wisley . .	K.	Aug.–Oct.	2	ov.	g.y.r.flu.
Mannington's Pearmain . .	Many . .	D.	Nov.–Mar.	2	r.	g.r.flu.rus.
Margil . .	,, . .	,,	Oct.–Jan.	2	r.c.	y.br.r.flu. rus.
Marston Scarlet Wonder . .	Wisley . .	K.	Nov.–Jan.	3	r.	r.
Martin's Seedling	Lincs., N. Ireland	,,	Oct.	2	,,	y.
Mary Barnes .	Cumb. . .	,,	Till May	2	f. ang.	g.str.fl.br. r.
Matthew's Seedling	I. of W. .	D.	Oct.–Jan.	2	r.c.	g.r.flu.
Maybloom . .	Sussex . .	K.	—	2	c.irr.	y.r.flu.
May Queen . .	Kent, Wisley .	D.	Feb.–May	2	fl.	y.r.flu.rus.
Melba . .	,,	,,	Aug.–Sept.	2	c.	y.r.str.
Melon Apple .	Herts., Wisley	,,	Dec.–Jan.	2	r.c.	y.r.flu.str.
Mère de Ménage (*syn.* Harlow Pippin, Winter Colmar) . .	Many . .	K.	Jan.–Mar.	3	r.fl. irr.	g.y.r.flu. str.
Michaelmas Stubbard . .	Long Ashton .	,,	—	2	c.	g.br.r.flu.
Middle Green .	Sussex . .	D.	Dec.–Feb.	2	r.c.	y.r.str.
Miller's Seedling .	Many . .	,,	August	2	c.	y.r.str.flu.
Millet . .	Wisley . .	K.	Aug.–Sept.	2	,,	y.
Millicent Barnes .	,, Herts.	D.	Oct.–Dec.	2	,,	y.r.str.
Minchall Crab .	,, . .	K.	Jan.–Mar.	3	r.irr.	g.y.r.flu. str.
Missing Link .	,, . .	D.	Oct.–Jan.	2	c.	g.y.br.flu.
Molleskov . .	,, . .	D. or K.	Oct.–Nov.	2	r.irr.	str.

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
Monarch . .	Many . .	K.	Nov.–Mar.	3	r.	y.r.str.
Monstrous Pippin. *See* Gloria Mundi.						
Morgan's Sweet .	Long Ashton, Mon.	K. Cider	Nov.–Dec.	2	c.	y.r.flu.
Morley's Seedling	Wisley . .	K.	Nov.–Feb.	3	r.	g.y.
Moss Orchard .	Sussex . .	D.	—	2	fl. irr.	g.y.r.flu. str.
Moston Seedling .	Cheshire .	K.	Nov.	2	c.	g.y.str.br.
Mother (*syn.* American Mother Queen Mary) .	Many . .	D.	Oct.–Nov.	2	,,	y.r.flu.str.
Mother Margaret .	Staffs.	—	—	—	—	—
Mountney's Seedling . .	Notts. . .	K.	—	2	r.	g.y.r.str. flu.
Mr. Prothero .	Wisley . .	D.	Jan.–Mar.	3	,,	y.r.flu.str.
Mrs. Barron .	,, . .	K.	Oct.–Jan.	2	,,	y.
Mrs. Lakeman's Seedling . .	Northumberland, Wisley	D.	Dec.–Feb.	3	fl. irr.	y.br.flu.
Mrs. Phillimore .	Wisley, Berks.	,,	Jan.–Mar.	2	c.irr.	y.r.flu.str.
Mrs. Toogood .	Lincs. . .	,,	Oct.–Nov.	2	,,	,,
Munster Pippin .	Cork . .	K.	,,	2	,,	str.r.
Murfitt's Seedling.	Herefordshire, N. Ireland	,,	Jan.–Mar.	2	r.c.	g.y.
Nailsea White .	Long Ashton .	,,	Nov.–Dec.	2	r.	pale g.y.
Nancy Hopkins .	Berks.	—	—	—	—	—
Nancy Jackson .	Many . .	,,	Jan.–Mar.	2	c.	y.r.flu.str.
Nancy Nock .	Shropshire .	K.	Oct.–Nov.	2	r.c.	y.r.flu.
Nanny . .	,, . .	D.	Dec.–Feb.	2	r.fl.	,,
Nelson Codlin .	Reading .	K.	Dec.–Jan.	3	c.	g.y.
Nelson's Glory .	Scotland .	,,	Nov.–Feb.	3	r.irr.	,,
New Bess Pool .	Kent . .	,,	Jan.–Mar.	2	r.	g.y.br.r. flu.
New Hawthornden	Wisley . .	,,	Oct.	3	,,	g.y.r.flu.
New Northern Greening . .	Cheshire, Wisley .	,,	Jan.–Mar.	2	,,	g.r.flu.str.
Newton Wonder .	Many . .	,,	Nov.–Mar.	3	,,	y.r.flu.str.
Newtosh . .	Wisley . .	D.	—	2	r.c.	g.y.r.flu.
Newtown Pippin .	Lincs. . .	,,	Dec.–Mar.	3	,,	g.y.
Nonpareil . .	Cork . .	,,	Jan.–Mar.	1	c.	g.y.br.r. flu.
Norfolk Beauty .	Many . .	K.	Oct.–Dec.	3	r.	y.r.flu.
Norfolk Beefing .	Wisley . .	,,	Jan.–April	2	r.fl.	g.r.flu.
Norfolk Challenger	,, . .	D.	Oct.–Dec.	2	c.	y.r.flu.str.
Norman's Pippin .	,, . .	,,	Jan.–Mar.	2	r.	g.y.r.flu. rus.
North Britain Giant . .	Cumb. . .	K.	July–Aug.	2	r. to c.	y.p.flu.
Northern Spy (*syn.* King Apple) .	E. Malling, I. of W.	D.	Jan.–Mar.	2	c.	g.y.r.flu. str.
Northern Star .	Sussex . .	D.	Jan.–May	1	r.	g.
Nunnick Red .	Scotland .	—	—	—	—	—
Nutmeg Pippin .	Wisley . .	D.	Jan.–Mar.	1	c.	y.rus.
Old Nonpareil .	Kent . .	,,	Jan.–May	2	r.	y.g.br.r. flu.rus.
Old Paul . .	Herts. . .	K.	Dec.	2	,,	r.
Old Pearmain .	Many . .	D.	Nov.–Jan.	2	c.	g.y.r.flu. rus.
Old Pippin . .	Cumb. . .	,,	Sept.–Nov.	2	,,	y.br.
Old Russet . .	Sussex . .	,,	Jan.–April	2	r.	rus.

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
Onibury Pippin .	Shropshire .	—	—	—	—	—
Ontario . .	Many . .	D. or K.	Jan.–April	2	r.irr.	y.r.flu.str.
Opalescent . .	Wisley . .	,,	Nov.–Feb.	3	c.	r.
Orange Pippin .	Kent . .	D.	Dec.–Jan.	2	r.	y.flu.r.
Orenca . .	,,	—	—	—	—	—
Orinoco . .	E. Malling .	—	—	—	—	—
Orleans . .	Wisley . .	D.	Oct.–Dec.	2	r.fl.	g.y.r.flu. str.
Orleans Reinette .	Many . .	,,	Dec.–Feb.	2	fl.	y.r.flu.
Oslin . . .	Wisley . .	,,	Aug.–Sept.	2	r.fl.	y.r.str.
Oversea Peggy .	Cumb. . .	K.	Sept.	2	r.rib.	g.r.str.
Owen Thomas .	Kent, I. of Ely	D.	Aug.	1	r.fl.	y.r.str.
Packington . .	Derby . .	,,	—	2	c.	r.
Paignton Marigold	Devon . .	D. or K.	Sept.–Oct.	2	r.fl.	y.r.str.flu.
Paradise Pippin .	Wisley . .	,,	Oct.	2	c.	y.r.str.
Paroquet . .	Many . .	,,	Nov.–Jan.	2	,,	r.
Patricia . .	Wisley . .	D.	Sept.–Nov.	1	r.	,,
Peacemaker .	Many . .	,,	Oct.–Nov.	2	,,	y.str.r.
Peachy Apple .	Wisley . .	,,	,,	2	,,	g.y.
Peacock . .	Lincs. . .	,,	Sept.	2	c.	y.r.str.
Pearvine . .	Sussex	—	—	—	—	—
Peasgood's Nonsuch (*syn.* Wolf River) . .	Many . .	K.	Sept.–Nov.	3	r.	y.r.flu.str.
Peck's Pleasant .	Cumb. . .	—	Oct.–Jan.	2	ob.	g.br.flu.
Pederstrup Reinette . .	Wisley . .	D.	Nov.–Jan.	2	r.	y.r.str.flu.
Pedro . .	,, . .	,,	Oct.	3	r.irr.	g.br.r.flu.
Perkin's A1. *See* Lane's Prince Albert.						
Pershore Pippin .	Cumb. . .	—	—	—	—	—
Peter Lock . .	Devon, Wisley	K.	Nov.–Feb.	3	r.irr.	g.r.str.
Peter Smith .	Long Ashton .	D.	—	—	—	—
Pettit Pippin .	E. Malling .	—	Dec.–Jan.	1	r.fl.	y.r.flu.
Pewaukee . .	Kent . .	D.	Nov.–Jan.	2	,,	y.
Pigeon Rouge .	Surrey . .	,,	,,	2	c.	y.r.str.flu.
Pigs Snout. *See* Catshead.						
Pike's Pearmain .	Derby . .	D.	Nov.–Jan.	2	ob.	y.br.flu.
Pine Apple Russet	Suffolk, Wisley	,,	Oct.–Nov.	2	r.ob.	g.br.rus.
Pine Golden Pippin	Wisley . .	,,	,,	1	r.fl.	g.rus.
Pitcher . . .	Cornwall .	K.	Nov.–Dec.	2	r.	y.
Pitmaston Nonpareil . .	Kent, Wisley .	D.	Nov.–Jan.	2	,,	y.br.flu. rus.
Pitmaston Pine Apple . .	Herts. . .	,,	Oct.–Dec.	1	c.	y.rus.
P. J. Bergius .	Wisley . .	,,	Sept.–Oct.	2	,,	y.r.str.
Ploughman . .	Scotland .	—	—	—	—	—
Pomme de Neige .	Kent . .	D.	Nov.–Jan.	2	r.	y.r.flu.
Ponsford . .	E. Malling, Devon	K.	Feb.–Mar.	2	fl.	g.
Poolkeeper . .	Cumb. . .	D. or K.	Jan.–Feb.	2	c.irr.	y. & dark r.
Possington . .	Sussex . .	,,	Sept.	2	c.	y.
Pott's Seedling .	Many . .	K.	Oct.–Nov.	3	r.	g.y.
Pound, The .	Sussex . .	,,	Jan.	3	c.ob.	g.
Poveys' Seedling .	Staffs. . .	D. or K.	Dec.–April	2	c.	g.y.
Powell's Russet .	Long Ashton .	D.	Nov.–Feb.	1	r.	br.rus.
Premier . .	Kent, Wisley .	,,	Aug.–Sept.	2	r.irr.	y.r.str.flu.
Price's Seedling .	Gloucester .	—	—	—	—	—
Prince Albert. *See* Lane's Prince Albert.						

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
Prince Edward	—	D. or K.	Dec.–Feb.	2	r.c.	y.r.flu.str.
Prince's Pippin	Gloucester	D.	Nov.–Dec.	2	c.	y.r.str.
Prizetaker. *See* Ecklinville Seedling.						
Proctor's Seedling	Lancs.	—	—	—	—	—
Profit (*syn.* Lane's Prince Albert)	—	—	—	—	—	—
Pruchie Pippin	Cumb.	—	—	—	—	—
Pryors Red	Surrey	D.	Oct.–Dec.	2	r.	y.r.str.
Pursemouth	Cumb.	K.	Oct.–Dec.	2	c.irr.	g.y.r.str.
Pyleigh	Long Ashton	—	—	—	—	—
Queen	Many	K.	Oct.–Dec.	3	r.fl.	y.r.str.flu.
Queen Alexandra	Wisley	D. or K.	,,	2	r.	g.y.r.str. flu.
Queen Anne	Long Ashton	K.	—	2	r.irr.	g.y.r.flu.
Queen Caroline (*syn.* Spencer's Favourite)	Kent, Wisley	,,	Oct.–Dec.	2	r.	g.y.
Queen Mary. *See* Mother.						
Queening	Sussex	—	—	—	—	—
Quench	Devon	D.	—	2	c.	g.r.flu.str.
Radcliffe's Nonpareil	Long Ashton	,,	Nov.–Jan.	1	r.	g.y.br.flu.
Radford Beauty	Herefordshire	D. or K.	Oct.–Dec.	2	r.fl.	g.y.r.str.
Rambour Franc	Kent, Worcs.	K.	Sept.–Oct.	3	r.irr.	y.r.str.rus.
Rambour Papaleu	Kent, Wisley	D. or K.	Jan.–Mar.	3	ob.c.	g.y.r.str. flu.
Rank Thorne	Cumb.	K.	Jan.–Feb.	2	r.	r.
Rather Ripe	Surrey	D.	Sept.	1	c.	y.
Ravelston Pippin	Edinburgh	,,	Aug.–Sept.	2	c.irr.	y.r.str.rus.
Red Annette	Sussex	,,	Sept.	1	,,	r.
Red Bramley's Seedling. *See* Crimson Bramley.						
Red Coat Grieve	Berks., Wisley	,,	Oct.	2	c.	y.r.str.flu.
Red Custard	Cumb.	,,	Oct.–Nov.	1	,,	y.r.
Red Hawthornden. *See* Yorkshire Beauty.						
Red Margaret. *See* Duchess's Favourite.						
Red Newton. *See* Crimson Newton Wonder.						
Red Quarrenden. *See* Devonshire Quarrenden.						
Red Rover. *See* Red Victoria.						
Red Victoria (*syn.* Red Rover)	Many	K.	Sept.	3	r.irr.	r.
Red Wing	Berks., Wisley	,,	Oct.	2	,,	y.r.str.
Reid's Seedling	Sussex	K. or D.	Dec.–Jan.	3	r.fl.	r.str.
Reinette de Chêne	Long Ashton	D.	Mar.	3	r.irr.	—
Reinette Descadre	Herts.	,,	Dec.–Mar.	2	c.	—
Reinette du Canada	Many	,,	Jan.–April	3	r.c.	g.y.br.flu. rus.
Reinette Rouge Etoilée (*syn.* Ster Apfel, Calville Rouge Précoce)	Kent, Wisley	,,	Oct.–Dec.	2	r.	y.r.flu.str.

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
Reinette Zuccamaglio	Kent	D.	Mar.–May	2	r.irr.	y.
Rev. J. B. Hall	Cumb.	K. or D.	Jan.–Mar.	3	r.fl.	g.y.r.str.
Rev. W. Wilks	Many	K.	Sept.–Nov.	3	r.	w.r.str.
Reynolds Peach (*syn.* Emperor Napoleon) ?	—	D. or K.	Aug.–Sept.	2	c.	y.r.flu.
Rhode Island Greening	Herts., Wisley	,,	Jan.–April	3	r.c.	g.y.
Ribston Pearmain. *See* King's Acre Pippin.						
Ribston Pippin	Many	D.	Nov.–Jan.	2	r.c. irr.	y.br.flu. str.rus.
Richard Gilbert	Sussex	K.	Oct.–Nov.	3	c.irr.	y.r.str.
Ringer	Wisley	D.	Oct.–Jan.	2	r.irr.	y.r.flu.
Ringstadable	Reading, Wisley	,,	Sept.–Oct.	2	r.	g.r.flu.
Rival	Many	D. or K.	Oct.–Dec.	2	r.fl.	y.r.flu.str.
Rivers' Early Peach	Wisley	D.	Aug.	2	r.c.	y.r.flu.
Robert Blatchford	Norfolk	K.	Oct.–Dec.	2	r.irr.	g.y.
Rolland Green. *See* Yorkshire Beauty.						
Rome Beauty	Kent	D. or K.	Jan.–May	3	r.	y.r.flu.str.
Rosamund	Wisley	D.	Sept.–Oct.	2	,,	r.
Rose of Sharon	Cheshire	D. or K.	Dec.–Feb.	2	c.	g.str.br.
Rosebery	Many	D.	Sept.–Oct.	2	r.	r.
Rosemary Russet	,,	,,	Dec.–Feb.	2	,,	y.r.flu.rus.
Ross Nonpareil	Wisley	,,	Nov.–Jan.	2	,,	y.r.flu.str. rus.
Rosy Blenheim	,,	,,	Oct.–Jan.	2	,,	r.
Rougemont	Many	,,	Sept.	2	ob.	y.r.flu.str.
Round Winter Nonsuch	I. of W.	K.	Nov.–Feb.	3	r.	g.y.r.flu. str.
Roundway Magnum Bonum	Many	D. or K.	Jan.–Mar.	3	r.fl.	g.y.br.flu. str.
Royal George. *See* Clark's Seedling.						
Royal Jubilee (*syn.* Jubilee)	,,	K.	Oct.–Dec.	2	c.	g.y.r.flu.
Royal Late Cooking	Reading, Wisley	,,	Jan.–Mar.	3	r.c.	g.y.rus.
Royal Seedling	Cheshire	,,	Dec.–Feb.	2	ob.	g.r.flu.
Royal Snow. *See* Pomme de Neige.						
Royal Somerset	Devon, Long Ashton	,,	—	2	r.	y.r.str.
Ruby	Wisley	D.	Oct.–Nov.	2	,,	y.r.str.flu.
Ruddy	Cumb.	,,	Sept.	2	,,	y.r.flu.
Rushcock Pearmain	Berks.	,,	Nov.–April	2	c.	y.br.r.flu. rus.
Rymer	Herts., Kent	K.	Jan.–Mar.	2	r.c.	r.flu.str.
Sack and Sugar	Staffs., Surrey	D. or K.	Sept.–Oct.	2	,,	y.
Safstanholm	Wisley	D.	Nov.	2	r.irr.	g.str.r.
St. Cecilia	Many	,,	Dec.–Mar.	2	c.	g.br.r.flu. str.
St. Edmund's Pippin	,,	,,	Oct.–Nov.	1	fl.r.	gld.rus.

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
St. Edmund's Russet. *See* above.						
St. Everard . .	Many . .	D.	Sept.	2	r.	y.r.flu.str.
St. Martins . .	Wisley . .	,,	Dec.–Feb.	2	ov.	y.br.r.flu.
Saltcote Pippin .	Many . .	,,	Nov.–Jan.	2	c.irr.	g.y.r.flu. str.rus.
Sally . . .	Sussex . .	,,	Dec.–Jan.	2	fl.	rus.
San Jacinto . .	Kent	—	—	—	—	—
Sandlin Duchess .	Wisley . .	D. or K.	Jan.–May	2	r.	y.flu.r.
Sandringham .	Many . .	K.	Nov.–Feb.	3	c.	y.r.flu.str.
Sanspareil . .	,, . .	D. or K.	Jan.–April	2	,,	,,
Scarlet Crofton. *See* Crofton Scarlet.						
Scarlet Golden Pippin . .	Herts. . .	D.	Jan.–Mar.	1	r.	y.r.flu.
Scarlet Nonpareil	Wisley . .	,,	,,	2	c.	y.r.rus.
Scarlet Pearmain .	,, . .	,,	Sept.–Nov.	2	,,	r.flu.str.
Scarlet Prince .	Sussex . .	,,	Nov.	2	,,	r.
Schoolmaster .	Wisley . .	K.	Oct.–Jan.	2	r.c.	g.r.flu.
Scilly Pearl .	,, . .	D.	Sept.–Oct.	2	r.	w.y.
Scotby . .	Cumb. . .	—	—	—	—	—
Scotch Bridget .	Many . .	K.	Oct.–Jan.	2	r.irr.	g.y.r.str.
Seabrook's Red .	Wisley . .	D.	Oct.	2	r.	y.r.str.flu.
Seaton House .	,, . .	K.	Oct.–Jan.	2	r.fl.	y.r.flu.
September Beauty	Wisley . .	D.	Sept.	2	—	—
September Scarlet	Lincs. . .	,,	Sept.–Oct.	1	r.	y.r.str.
Sharleston Pippin. *See* Domino.						
Sharon . .	Wisley . .	,,	Oct.–Nov.	2	c.	g.y.r.flu.
Sheep's Snout .	Kent . .	K.	Oct.–Nov.	2	c.irr.	y.r.str.
Signe Tillisch .	Wisley . .	,,	Oct.–Dec.	3	,,	y.br.r.flu.
Sir Benjamin Baker . .	I. of W. .	D.	—	2	r.c.	y.flu.str.r.
Sir Douglas Haig .	,, . .	D. or K.	Oct.–Nov.	2	r.	y.str.r.
Sir John Thornycroft . .	Many . .	D.	Oct.–Dec.	2	,,	y.r.flu.str.
Skovfogedaeble .	Wisley . .	K.	Nov.–Dec.	2	r. irr.	g.r.str.
Sleeping Beauty .	Lincs. . .	,,	Nov.–Feb.	2	r.	y.r.flu.
Sloto . . .	Kent . .	—	—	—	—	—
Slotraeble . .	Wisley . .	K.	Nov.–Dec.	3	r.c.	g.r.str.flu.
Small's Admirable	Herts., Kent .	,,	Nov.–Feb.	2	r.	g.y.
Smeller . .	Sussex . .	D.	Sept.–Oct.	2	,,	y.
Sonderskon . .	Kent . .	—	—	—	—	—
Sops-in-Wine .	Many . .	K.	Oct.–Dec.	2	r.c.	y.r.flu.
Sowman's Seedling . .	Wisley . .	,,	Aug.–Sept.	2	r.	g.y.
Sovereign . .	Scotland .	—	—	—	—	—
Spaniard (The) .	Glam. . .	K.	Sept.–Oct.	1	r.fl.	y.
Spencer's Favourite. *See* Queen Caroline.						
Spice . . .	Herefordshire	D.	Nov.–Feb.	2	r.	y.r.str.
Squire's Pippin .	Lincs. . .	K.	Dec.–April	2	r.fl.	g.br.r.flu.
Stanway Seedling	Wisley . .	D.	Oct.–Nov.	2	c.	y.r.str.
Star of Devon .	Many . .	,,	Nov.–Feb.	2	r.c.	y.r.flu.str.
Ster Apfel. *See* Reinette Rouge Etoilée.						
S. T. Wright	Wisley . .	K.	Oct.–Nov.	3	r.irr.	y.r.str.flu.
Steyne Seedling .	I. of W. .	D. or K.	Oct.–Dec.	2	r.	y.r.str.
Stirling Castle .	Many . .	K.	Sept.–Oct.	2	,,	g.y.
Stobo Castle .	Wisley . .	,,	Oct.	2	r.irr.	g.r.str.
Stocker's Seedling	Cornwall .	D.	Mar.–April	2	r.c.	g.rus.

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
Stoke Edith Pippin	E. Malling .	K.	Sept.	2	c.	g.y.r.flu. str.
Stone Pippin .	Hants. . .	D.	Jan.–May	1	r.	y.rus.
Stone's (*syn.* Loddington) . .	Many . .	K.	Nov.–Jan.	3	ob.c.	g.y.r.flu. str.
Stonetosh . .	Wisley . .	D.	Oct.–Dec.	2	r.	y.r.str.flu.
Strawberry Apple	Sussex . .	,,	Sept.	1	c.	y.r.flu.
Strawberry Hill .	Cornwall, Oxford	K.	Jan.–Feb.	2	fl.r.	g.r.flu.
Strawberry Pippin	Cornwall .	,,	Oct.–Dec.	2	,,	y.r.str.flu.
Striped Beefing .	Many . .	,,	Jan.–May	3	r.irr.	g.r.str.
Stripes . .	Sussex, Oxford	,,	—	2	,,	g.y.r.str.
Sturmer Pippin .	Many . .	D.	Jan.–May	2	r.	g.y.br.flu.
Sugar and Cream. *See* Emperor Alexander.						
Summer Gillyflower . .	—	,,	—	3	c.	g.r.str.
Summer Golden Pippin . .	Wisley . .	,,	Aug.	1	r.	y.r.flu.
Sunburn . .	,, . .	,,	Nov.–Feb.	2	,,	y.r.str.flu.
Sunglow . .	Sussex . .	—	—	—	—	—
Superb. *See* Laxton's Superb.						
Sure Crop . .	Wisley . .	K.	Jan.–Mar.	2	r.	g.
Sussex Forge. *See* Forge.						
Swan's Egg .	Sussex . .	D.	Nov.	1	c.	y.
Sweet Cleave. *See* Flanders Pippin.						
Sweet Lading .	Wisley . .	K.	Oct.–Dec.	2	r.	g.y.r.str.
Syke House Russet	Herts., Kent .	D.	Nov.–Feb.	1	r.fl.	y.rus.
Tamplin . .	Wisley . .	,,	Nov.	3	r.c.	r.str.
Tank . . .	Sussex . .	K.	Feb.–Mar.	3	c.	r.str.rus.
Templar . .	Yorks. . .	,,	Sept.–June	2	r.	g.
Ten Commandments . .	Herefordshire	D. or K.	Nov.	2	,,	y.r.str.flu.
Ten Shillings .	Lincs. . .	D.	Oct.–Nov.	2	,,	g.y.r.str. rus.
Tewkesbury Baron	Reading .	,,	Sept.–Oct.	2	,,	r.
Texola . .	Wisley . .	,,	—	2	c.	y.r.str.flu.
Thomas Jeffrey .	,, . .	,,	Sept.	2	r.fl.	r.
Thomas Rivers .	Many . .	K.	Sept.–Dec.	2	r.c.	y.r.str.flu.
Thorle . .	Wisley . .	D.	Aug.–Sept.	1	fl.	y.r.str.
Thorneyholme Seedling . .	Lancs. . .	?	Oct.–Nov.	1	ov.	dull crimson, bloomy
Thorpe's Peach .	Northants, Wisley	D.	Nov.–Jan.	2	c.	y.r.str.flu.
Thurso . .	Wisley . .	,,	Oct.–Nov.	2	r.irr.	g.y.r.flu.
Tiffen . .	Cumb. . .	K.	Autumn	2	r.	y.str.cr.
Tillington Court .	Herefordshire	K. or D.	Nov.–Jan.	2	c.irr.	y.r.str.flu.
Tom Montgomery	Sussex . .	D.	Sept.	1	r.	g.r.flu.
Tom Putt . .	Wisley, Berks.	K.	Sept.–Oct.	2	,,	r.flu.str.
Tower of Glamis .	Many . .	,,	Jan.–April	3	c.	g.br.flu.
Town Apple. *See* Duchess Favourite.						
Transparent de Croncels . .	Kent . .	D. or K.	Oct.–Dec.	3	ob.	y.br.r.flu.
Tun Apple . .	Wisley . .	D.	,,	2	c.	g.br.r.flu.
Twenty Ounce .	Many . .	K.	Nov.–Jan.	3	r.c.	y.r.str.flu.

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
Two Year Seedling	E. Malling .	D.	Mar.–May	2	ob.	y.r.flu.str.
Tyler's Kernel .	Many . .	K.	Jan.–Mar.	3	c.	y.r.str.
Tyneham Apple .	Berks. . .	D.	Nov.	2	r.fl.	,,
Tyvrestrup (*syn.* Court Pendu Plat) . .	—	—	—	—	—	—
Uland . .	Wisley . .	K.	—	2	c.irr.	g.y.r.flu.
Upton Pyne .	Many . .	D. or K.	Jan.–Mar.	3	c.	y.r.str.
Vicar of Beighton	,, . .	K.	—	3	r.irr.	g.r.str.flu.
Victory . .	Wisley . .	,,	Oct.	3	c.	y.r.str.
Vitgylling . .	,, . .	,,	Oct.–Dec.	3	r.irr.	g.r.str.
Wadhurst Pippin	Herts. . .	D. or K.	Jan.–Mar.	2	ob.c.	y.r.str.flu.
Wagener . .	Many . .	,,	Jan.–April	2	r.irr.	y.r.flu.str.
Waldron Beauty .	Kent . .	—	—	—	—	—
Waltham Abbey (*syn.* Dr. Harvey)	Cumb., Wisley	K.	Oct.–Dec.	3	r.c.	y.r.flu.
Wanstall Pippin .	Kent . .	D.	Jan.–June	2	r.	y.br.r.flu. str.
Warburton . .	Devon . .	—	—	—	—	—
Warner's King .	Many . .	K.	Dec.–Feb.	3	r.irr.	g.y.
Warren's Seedling	Cambs. . .	,,	,,	2	ov.	g.
Washington .	Many . .	,,	Oct.–Dec.	3	,,	y.r.flu.str.
Washington Nonpareil . .	Wisley . .	D.	—	2	c.	y.r.flu.str. rus.
Wealthy . .	Many . .	,,	Oct.–Nov.	3	r.	y.r.str.flu.
Wellington. *See* Dumelow's Seedling.						
Werder's Golden Reinette . .	Wisley . .	,,	Jan.–Mar.	2	,,	y.r.str.
Weston's Seedling	E. Malling .	K.	Sept.	3	r.c.	g.r.flu.
White Dutch Codlin	Sussex . .	,,	Oct.–Nov.	3	c.irr.	g.y.r.flu.
White Flanders .	I. of W. .	—	—	—	—	—
White Nonpareil .	Kent . .	D.	Dec.–Feb.	1	r.fl.	g.y.br.r. flu.
White Pippin .	Yorks. . .	K. or D.	Jan.–May	2	c.irr.	y.br.rus.
White Transparent	Wisley . .	D. or K.	Aug.	2	r.	pale y.
William Crump .	Many . .	D.	Dec.–Feb.	2	c.	y.r.str.flu.
William's Favourite	,, . .	,,	Aug.	2	ob.	,,
Wilson's Endeavour .	Herts. . .	D. or K.	Dec.–Mar.	2	r.irr.	g.flu.r.
Wilson's Prolific .	Kent . .	—	—	—	—	—
Wiltshire Defiance	Reading .	K.	Oct.–Nov.	3	c.	gr.
Windoor Early .	Herefordshire	—	—	—	—	—
Winter Banana .	Suffolk, Wisley	D.	Nov.–Feb.	3	c.	y.r.flu.
Winter Colmar. *See* Mère de Ménage.						
Winter Greening (*syn.* John Apple)	Staffs., Oxford	K.	Dec.–June	2	r.irr.	g.br.flu.
Winter Hawthornden . .	Wisley . .	,,	Oct.–Dec.	3	r.	y.g.r.flu.
Winter Majetin .	Lincs., Wisley	,,	Jan.–April	2	r.irr.	g.y.br.flu.
Winter Peach .	Sussex . .	,,	Jan.–Mar.	2	r.fl.	y.r.flu.
Winter Pearmain .	Suffolk . .	D.	Dec.–April	2	c.	g.y.r.str.
Winter Quarrenden	Suffolk, Kent	,,	Nov.–Dec.	2	r.fl.	r.
Winter Ribston (*syn.* Orleans Reinette) .	124 . .	—	—	—	—	—
Winter Strawberry	Sussex . .	K.	Dec.–Mar.	2	r.c.	y.r.str.
Winter Sunshine .	E. Malling .	D.	—	2	c.	,,
Wintersterne .	,, .	—	—	—	—	—
Withington Fillbasket . .	Kent, Lancs. .	K.	Oct.–Nov.	3	r.irr.	y.

Name.	Source.	Use.	Season.	Size.	Shape.	Colour.
Withington Welter	Cheshire .	K.	Sept.–Oct.	3	c.	g.
Wolf River. *See* Peasgood's Nonsuch.						
Woolbrook Pippin	Wisley . .	D.	Nov.–Feb.	2	r.	y.r.str.flu.
Woolbrook Russet	,, . .	D. or K.	Nov.–Mar.	3	,,	g.rus.br. flu.
Worcester Pearmain . .	Many . .	D.	Sept.–Oct.	2	c.	r.
Wormsley Pippin	Hereford .	K.	Oct.	2	r.	y.r.flu.
Wyken Pippin .	Many . .	D.	Nov.–Feb.	1	r.fl.	g.y.
Yellow Ingestrie .	,, . .	,,	Aug.–Sept.	1	r.c.	y.
Yellow Newton .	Kent, Herts. .	,,	Dec.–Mar.	3	c.irr.	,,
Yldrod Pigeon .	*Wisley* . .	,,	—	1	c.	y.r.flu.
York Imperial .	Herts,E.Malling	,,	Dec.–Feb.	1	r.fl.	y.r.flu.str.
Yorkshire Beauty (*syn.* Greenup's Pippin, Rolland Green) . .	Many . .	K.	Sept.–Dec.	3	r.	y.r.flu.
Yorkshire Greening	Wisley . .	,,	Dec.–Mar.	3	r.irr.	g.y.r.str. flu.

Cider Apples Exhibited at the Crystal Palace Show, September 1934.

Abbreviations Used.

Use.
shp. = sharp.
swt. = sweet.
bswt. = bittersweet.

Season.
m. = midseason.
l. = late.

Size.
1 = small.
2 = medium.
3 = large.

Shape.
c. = conical.
o. = oval.
r. = round.
f. = flat.
f.r. = flat round.
r.c. = round conical.

Colour.
str. = striped.
r. = red.
y. = yellow.
y. rus. = yellow russet.
g. = green.
br. = brown.
cr. = crimson.
w. = white.
c. rus. = crimson russet.

Variety.	Source.	Use.	Season.	Size.	Shape.	Colour.
Ailey Red	Hereford	sh.	m.	1	c.	str.
Ashton Dymock Red	Long Ashton	,,	,,	1	f.r.	r.
Ashwell Red Stripe	Somerset	,,	,,	2	c.	str.
Backwell Red	Somerset and Long Ashton	,,	,,	2	r.	,,
Bastard Tom Putt	Somerset	,,	,,	3	f.	,,
Bedan des Partes	Long Ashton	bswt.	l.	1	c.	y.
Beech Bearer	Devon	shp.	m.	3	f.c.	,,
Bell Apple	Dorset	bswt.	,,	3	c.	,,
Belle Norman	Monmouth	,,	,,	3	,,	,,
Bickington Gray	Devon	shp.	,,	1	r.	,,
Billy White	,,	swt.	,,	3	c.	str.
Black French	Worcester	bswt.	l.	1	,,	br.
Black Norman	Hereford	,,	,,	1	f.r.	cr.
Bloody Butcher	Somerset	shp.	m.	2	c.	,,
Bluey Sweet	Devon	swt.	,,	1	r.	y.
Bran Rose	Worcester	shp.	l.	1	,,	str.
Breakwell's Seedling	Monmouth	,,	early	1	c.	,,
Broadleaf Jersey	Long Ashton	bswt.	l.	3	,,	g.
Broadleaf Norman	Somerset and Long Ashton	,,	m.	3	,,	y.
Broadnose Jersey	Somerset	,,	,,	2	,,	str.
Broad Styre	Monmouth	shp.	,,	1	f.	y.
Broadtails	Worcester	,,	,,	1	c.	g.
Broom	Monmouth	,,	,,	1	r.	y.
Brown Jersey	Somerset	bswt.	,,	1	c.	br.
Brown Snout	Hereford	,,	,,	2	,,	g.
Brown's Apple	Devon	shp.	,,	2	r.	str.
Buddick	,,	,,	,,	2	c.	,,
Bulmer's Norman	Hereford and Long Ashton	bswt.	,,	3	,,	y.
Bunch Bloom	Somerset	shp.	l.	1	f.r.	cr.
Butter Box	Devon	,,	m.	2	c.	str.
Buttery d'Or	,,	,,	early	2	r.	y.
Cadbury	Somerset	bswt.	—	2	c.	,,

Variety.	Source.	Use.	Season.	Size.	Shape.	Colour.
Cap of Liberty	Somerset and Long Ashton	shp.	m.	2	c.	r.
Cherry Norman	Long Ashton	bswt.	,,	1	r.	str.
Cherry Pearmain	,, ,,	shp.	,,	2	,,	r.
Chisel Jersey	Devon, Somerset and Long Ashton	bswt.	l.	2	,,	c.rus.
Cluster Bittersweet	Worcester	,,	m.	1	,,	str.
Colebrook	Somerset	swt.	l.	2	,,	r.
Coleman's Seedling	Devon	shp.	,,	3	c.	str.
Coombe's Cadbury	Somerset	bswt.	m.	2	,,	,,
Corset Hill	Gloucester	shp.	,,	1	,,	,,
Court Royal	Somerset and Long Ashton	swt.	,,	3	f.	g.
Cowarne Red	Hereford	shp.	l.	2	r.	r.
Cowards	—	,,	,,	2	f.r.	str.
Cowsden Green	Worcester	,,	,,	1	f.	,,
Cremiere	Long Ashton	bswt.	,,	2	c.	y.
Crimson King	Somerset	shp.	m.	3	,,	cr.
Cummy Norman	Hereford	bswt.	,,	1	,,	y.
Dabinett	Somerset and Long Ashton	,,	l.	2	r.	r.str.
Davis' Favourite	Somerset	swt.	m.	1	c.	str.
DevonshireBittersweet	Worcester	bswt.	,,	3	r.	g.
Devonshire Red	,,	shp.	,,	2	c.	r.
Dove	Somerset	swt.	,,	2	,,	str.
Dove Seedling	,,	,,	,,	2	,,	,,
Doux Amer	Long Ashton	,,	,,	1	f.r.	g.
Dry Close	Somerset	shp.	,,	2	c.	,,
Dufflin	Long Ashton	,,	,,	1	r.	y.rus.
Early Bittersweet	,,	bswt.	early	2	c.	str.
Early Jersey	Somerset	,,	,,	1	,,	,,
Early Red Sharp	,,	shp.	,,	1	,,	r.
Early Sweetie	,,	swt.	,,	2	r.	y.
Early Yellow Sharp	,,	shp.	,,	2	c.	,,
Ecarlatine	Long Ashton	swt.	m.	1	r.	r.
Eggleton Styre	Hereford and Long Ashton	,,	,,	2	c.	y.
Ellis' Bitter	Devon	bswt.	,,	3	,,	r.
Fair Maid of Devon	,,	shp.	,,	2	r.	str.
Fair Maid of Taunton	Somerset	,,	,,	2	c.	,,
Farmers' Friend	,,	,,	l.	2	o.	,,
Fertile de Caen	Hereford	bswt.	m.	1	c.	,,
Fillbarrel	Somerset	shp.	,,	3	,,	,,
Fillon's Sharp	,,	,,	,,	2	r.	y.
Forsey	,,	bswt.	,,	—	—	—
Forte Cue	,,	shp.	early	3	f.r.	str.
Foxwhelp	Hereford and Long Ashton	,,	m.	2	r.	,,
Frederick	Monmouth and Long Ashton	,,	,,	2	,,	c.rus
French Long Stem	Devon	,,	,,	1	,,	,,
Frequin Audievre	Long Ashton	bswt.	l.	1	c.	r.
Gatcombe	Somerset	shp.	m	1	f.r.	y.
George James	,,	bswt.	,,	2	f.	str.
Gloucester Pippin	Monmouth	shp.	,,	1	c.	,,
Golden Ball	Devon and Dorset	,,	,,	2	r.	y.
Grandfield Jersey	Somerset	bswt.	l.	1	,,	str.
Great Britain	Devon	shp.	m.	3	c.	y.
Greasy Redstreak	Somerset	,,	,,	2	,,	str.
Green Bittersweet	Devon and Dorset	bswt.	,,	2	,,	g.
Green Jersey	Somerset	,,	,,	2	,,	,,

Variety.	Source.	Use.	Season.	Size.	Shape.	Colour.
Green Windsor . .	Somerset .	bswt.	m.	2	f.	g.
Hangdown . .	Somerset and Devon .	,,	,,	1	r.	y.
Hangdown Improved.	Devon . .	,,	,,	2	,,	,,
Hagloe Crab . .	Hereford and Gloucester .	shp.	l.	1	c.	,,
Hartisman . .	Somerset .	,,	,,	2	f.	r.
Harry Master's Jersey .	Somerset and Long Ashton	bswt.	,,	2	r.	str.
Honeystring . .	Somerset .	swt.	m.	1	c.	y.
Hope's Norman .	Hereford .	bswt.	,,	2	,,	str.
Improved Bittersweet	Devon . .	,,	,,	3	r.c.	y.r.
Ironsides . . .	Dorset .	shp.	l.	1	r.	g.
Italy . . .	Worcester .	bswt.	m.	1	c.	str.
Jenning's Bitter .	Somerset .	,,	,,	2	,,	,,
Jersey Bittersweet .	Dorset . .	,,	,,	2	f.	y.
Joeby Crab . .	Long Ashton .	shp.	l.	1	c.	str.
Jones' Sharp . .	Monmouth .	,,	m.	1	,,	y.
Kingston Bitter .	Long Ashton .	bswt.	l.	2	,,	str.
Kingston Black . .	Somerset and Long Ashton	shp.	,,	2	,,	cr.
King's Favourite .	Dorset . .	,,	,,	2	f.	str.
King Manning . .	Devon .	,,	m.	3	c.	y.
Kittisford Sour .	Somerset .	,,	l.	2	,,	str.
Knotted Kernel . .	Long Ashton .	bswt.	,,	1	,,	cr.
Lady's Finger . .	,, ,, .	shp.	early	3	,,	y.
Lambrook Beauty .	Somerset .	bswt.	l.	1	,,	str.
Lambrook Pippin .	Long Ashton .	shp.	,,	1	r.	,,
Langworthy . .	Devon . .	,,	m.	2	c.	,,
Late Bittersweet .	Worcester .	bswt.	l.	2	,,	,,
Lavignee . . .	Somerset .	,,	,,	2	,,	,,
Little Sweet . .	,, .	swt.	m.	1	,,	y.
London Jersey . .	,, .	,,	—	—	—	—
Long Stem (winter) .	Dorset . .	shp.	l.	3	,,	r.
Long Stem . .	Somerset .	,,	—	—	—	—
Lorna Doone . .	,, .	,,	m.	2	,,	str.
Major . . .	Long Ashton .	bswt.	early	2	,,	,,
Médaille d'Or . .	Somerset and Long Ashton	,,	l.	1	r.	y.rus.
Michelin . . .	Hereford .	,,	m.	2	c.	g.
Middle Street . .	Somerset .	,,	—	—	—	—
Monsieur Jacques .	Long Ashton .	,,	l.	1	,,	str.
Mullin's White . .	Monmouth .	,,	m.	1	r.	w.
Neverblight . .	Long Ashton .	shp.	l.	2	c.	y.
Nine Square . .	Somerset .	,,	—	—	—	—
Norton Bitter . .	Long Ashton .	bswt.	l.	2	c.	str.
Oakham Green . .	—	shp.	,,	2	r.	y.
Pear Pine . .	Devon . .	bswt.	—	—	—	—
Perthyre . . .	Monmouth .	,,	m.	3	c.	y.
Ponsford . . .	Devon . .	shp.	,,	3	,,	,,
Porter's Perfection .	Somerset and Long Ashton	,,	,,	2	,,	str.
Pound . . .	Devon and Dorset .	swt.	,,	3	f.	,,
Queen of the Vale .	Dorset . .	shp.	early	2	c.	y.
Rawlings . . .	Devon . .	,,	m.	1	,,	str.
Red Bittersweet .	Worcester .	bswt.	,,	1	,,	r.
Red French . .	Monmouth .	,,	,,	1	,,	,,
Red Jersey . .	Somerset .	,,	,,	2	,,	,,
Red Norman . .	Hereford and Worcester .	,,	,,	2	,,	y.r.blush
Red Worthy . .	Somerset .	,,	—	—	—	—
Redstreak . .	,, .	shp.	m.	2	c.	str.
Reinette Obry . .	Long Ashton .	,,	l.	3	r.	y.

Variety.	Source.	Use.	Season.	Size.	Shape.	Colour.
Rouge Bruyere	Long Ashton	shp.	m.	2	c.	r.
Rough Thorn	Worcester	bswt.	l.	2	,,	y.
Royal George	Somerset	shp.	m.	1	f.	str.
Royal Jersey	Long Ashton	bswt.	,,	2	r.c.	r.
Royal Jersey (Martock)	Somerset	,,	,,	2	c.	str.
Royal Snow	Worcester	swt.	,,	2	r.	r.
Royal Somerset	Devon	shp.	,,	2	,,	y.
Royal Wilding	Gloucester and Long Ashton	bswt.	,,	2	c.	g.
Runnaway	Dorset	swt.	,,	2	f.	st.
Russet Sweet	,,	,,	l.	2	f.r.	y.rus.
Sam Tannin	Somerset	bswt.	m.	3	c.	st.
Sandford Jersey	,,	,,	,,	1	,,	y.
Sercombe's Natural	Devon	shp.	,,	2	r.	cr.
Severn Bank	Worcester	,,	l.	2	c.	str.
Shapwick Apple	Somerset	bswt.	m.	3	,,	,,
Shapwick Sweet	,,	swt.	,,	3	,,	,,
Sheep's Nose	,,	shp.	,,	2	,,	y.
Sherrington Norman	,,	bswt.	,,	2	r.	,,
Shrawley Bittersweet	Worcester	,,	,,	2	f.	str.
Silver Cup	Somerset and Long Ashton	,,	,,	2	r.	y.
Slack-ma-Girdle	Devon	swt.	,,	3	f.	str.
Somerset Crab	Dorset	shp.	l.	3	c.	g.
Somerset Foxwhelp	Somerset	,,	m.	2	,,	str.
Somerset Woodbine	,,	swt.	,,	3	r.	,,
Sour Hangdown	,,	shp.	,,	1	,,	y.
Sour Reinette	Dorset	,,	,,	2	,,	g.
Sour Vallis	Gloucester	,,	l.	1	c.	str.
Sour Woodbine	Devon	,,	,,	2	f.	,,
Sparklers	Somerset	swt.	,,	2	c.	,,
Spotted Dick	Devon	,,	,,	1	,,	w.
Spicy Pippin	,,	shp.	,,	2	,,	str.
Stable Jersey	Somerset	bswt.	,,	2	,,	,,
Stoke Red-stripe	,,	shp.	,,	2	,,	,,
Stoke Bittersweet	,,	bswt.	,,	—	—	—
Stone Pippin	Devon and Dorset	shp.	l.	2	f.	g.
Strawberry Apple	Worcester	,,	,,	2	c.	str.
Strawberry Norman	Hereford and Long Ashton	bswt.	m.	2	,,	,,
Strickland Bitter	Somerset	,,	,,	2	,,	,,
Sugar Loaf	Devon	swt.	,,	2	,,	y.
Sugar Sweet	,,	,,	,,	2	r.c.	,,
Sutton Redstreak	Somerset	bswt.	,,	2	c.	str.
Sweet Alford	Devon and Long Ashton	swt.	,,	3	f.c.	y.
Sweet Bay	Devon	bswt.	,,	1	c.	,,
Sweet Blenheim	Somerset	swt.	,,	3	f.	str.
Sweet Bramley	Devon	,,	,,	3	,,	g.
Sweet Coppin	Devon and Long Ashton	,,	l.	3	c.	str.
Sweet Cluster	Devon	,,	m.	1	f.	,,
Sweet Tom Putt	Somerset	,,	,,	2	c.	,,
Syme's Seedling	,,	shp.	—	—	—	—
Tardive Forestier	Long Ashton	bswt.	l.	2	c.	str.
Thomas Hunt	Somerset	swt.	,,	1	r.	y.rus.
Tom Legg	Dorset	,,	m.	2	c.	y.
Tom Putt	Worcester and Dorset	shp.	,,	3	f.c.	str.
Tom Farmer	Somerset	bswt.	,,	1	r.c.	,,
Tommy Rodford	,,	,,	l.	3	c.	,,
Toogood's Bitter	,,	,,	m.	2	,,	,,
Tremlett's Bitter	Devon	,,	,,	3	,,	r.

Variety.	Source.	Use.	Season.	Size.	Shape.	Colour.
Twistbody Jersey	Somerset	bwst.	m.	2	c.	str.
Upright French	Hereford	,,	,,	1	o.	g.
Upright Styre	,,	,,	,,	—	—	—
Vallis	Gloucester	shp.	,,	2	r.	cr.
Virgin	Somerset	bswt.	,,	3	c.	y.r.fl.
Welland Hangdown	Worcester	,,	,,	1	r.	y.
Welland Red	,,	shp.	,,	2	c.	r.
Whimple Queen	Devon	,,	,,	2	,,	st.
Whimple Wonder	,,	,,	l.	2	,,	y.
White Alphington	Long Ashton	swt.	m.	2	,,	w.
White Close Pippin	,, ,,	bswt.	,,	2	,,	str.
White Jersey	,, ,,	,,	early	1	,,	y.
White Norman	Hereford and Worcester	,,	m.	1	,,	w.
White Sharp	Somerset	shp.	,,	2	,,	,,
White Sheep's Nose	Devon	,,	,,	2	,,	,,
White Spice	Somerset	,,	,,	1	,,	,,
Wilding Neverblight	,,	,,	l.	1	,,	g.
Winter Stubbard	Devon	,,	,,	2	o.	y.
Worcester Red	Monmouth	,,	m.	1	c.	r.
Yarlington Mill	Somerset and Long Ashton	bswt.	,,	2	,,	str.
Yeovil Sour	Somerset	shp.	l.	2	,,	y.

N.B.—Certain of the varieties whose names are printed in **thick type** are subject to canker in some localities, and before they are selected for planting local information as to their behaviour should be sought.

FOREIGN APPLES EXHIBITED.

BALTIC STATES.

Laxton's Superb.
Signe-Tillish.
Minister von Hammerstein.
Trebaux.
Antonowka.

BELGIUM.

Reinette Etoilée.
Reinette Descardre.
Posson de Hollande (Sabot d'Eysden).
Belle de Boskoop.
Belle-Fleur large mouche (Belle-Fleur de France).
Marie-Joseph d'Othée.

DENMARK.

Bellefleur de France.
Bramley's Seedling.
Belle de Boskoop.
Filippa.
Cox's Pomona.
Cox's Orange.
Boiken.
Pederstrup.
Gul Graasten.
Codlin Springrove.
Ildrod Pigeon.
Sonderskov.

FRANCE.

Amélie.
Canterbury.
Calville blanche.
Châtaignier.
Dean's Codlin.
Douce de Hollande.

FRANCE—*continued.*

Grande Alexandre.
Karanfel Alma.
Kanpanger.
Queen (Borsdorf).
Reinette blanche du Canada.
Reinette de Dieppedalle.
Reinette de Fromm.
Reinette de Landsberg.
Reinette de Multhaupt.
Reinette du Roi.
Rose de Moringen.
Royale d'Angleterre.
Winter Banana.
Wagener.

HOLLAND.

Zoete Bloemee.
Groninger Kroon.
Lemoen Appel.
Notaris Appel.
Sterappel (Reinette Rouge Etoilée).
Zoete Campagne.

SWITZERLAND.

Ruzberger Wilding.
Damason Reinette.
Berner Rosen.
Seelander Reinette.
Edelgrauech.
Erdbeeraffel von Quzenstorp.
Forellen Reinette.
Sauergranech.
Chusenrainer.
Melchnauer Somtagsappel.
Herefordshire Parmane.
Roter Seeappel.

FOREIGN APPLES.

By E. A. BUNYARD.

THE collections of Apples so kindly sent by several foreign correspondents were of considerable interest and served, in some cases, to clear up, or confirm, several questions of synonymity.

From Switzerland, the Zentrolstelle fur Obstbau at Olschberg, came several interesting varieties, and the most attractive to the eye was perhaps that named 'Damason Reinette,' intermediate in appearance between 'Cox's Orange' and 'Ross Nonpariel.' This is a very old Apple which, under its original name, 'Reinette de Macon,' was listed by LE LECTIER in 1628. Authors who have since described it are at variance as to its quality and the writer awaits its ripening, after Christmas, before giving an opinion.

Among the coloured varieties the 'Berner Rosenappel' was remarkable, and from the illustration in the latest Swiss Pomology, the Schweizerisches Obstbilderwerk, I had thought this fruit was our 'Gascoyne's Scarlet' under a new name. Examination, however, proves that it is quite distinct. It was found near Opplingen, Switzerland, and first fruited in 1888. Its main virtues, however, appear to be external.

The 'Roter Seeappel' would fall into the 'Duchess's Favourite' group, a bright fruit of no outstanding quality.

'Seelander Reinette' is a hard green fruit, reported to keep until the next autumn, and, indeed, it has every external promise of so doing. One may describe it as intermediate between 'French Crab' and 'Norman's Pippin.'

'Sauergrauch' and its larger edition, 'Edelgrauch,' are popular Swiss Apples, and will be worth trying later on as they ripen.

It was curious to find in this collection, as in some other foreign ones, old English Apples now almost lost to cultivation. One of these was the 'Herefordshire Pearmain.' This agrees with the one I have always known and that figured by HOGG in the "Hertfordshire Pomona," but the figure in Ronald's "Pyrus Malus Brentfordiensis" is wrong.

'Forellen Reinette,' the 'Trout Reinette,' is an Apple of great antiquity, and is better known abroad as the 'Carmeliter Reinette.' Its wanderings may be indicated by the fact that it has at various times been called the French, Dutch and English 'Reinette.' The earliest record is probably that of MERLET in the seventeenth century. In appearance it is that of a shorter, evenly rounded 'Adam's Pearmain.'

In the collection from Denmark were several fruits of great interest. 'Boiken,' much grown in countries bordering the Baltic, has a great resemblance to our 'Winter Majetin,' and from an external examination they might well be pronounced identical. The core, however, shows striking differences, as do the leaves, and there can be no doubt that they are distinct. 'Winter Majetin' probably keeps longer.

Several other Danish Apples, such as 'Filippa,' 'Reinette Pederstrup,' 'Sonderskov,' etc., are on trial at Allington and Wisley, and it was interesting to compare the fruits from their own country. English Apples, such as 'Bramley's Seedling,' 'Cox's Pomona' and 'Cox's Orange,' seem to do excellently in Denmark, judging by the samples sent.

From Esthonia came a small and interesting collection, and it was valuable in showing that the Russian Apple 'Antonowka' grown so far in this country is not the true variety, which may be described as a larger 'Transparent de Croncels.' The fruit sent corresponds exactly with the figure in the Atlas Plodov of GREBNITZKY, published in 1903 at Petrograd.

The collection from Holland contained the Apple we grow as 'Reinette Rouge Etoilée,' but which is a popular market variety in Holland under the name of 'Sternapfel,' and in Belgium also. Some

fine fruits of the 'Limonen Reinette,' resembling a green 'Belle de Boskoop,' and certainly distinct from our 'Lemon Pippin,' were shown. This agrees very well with the 'Reinette Limon' of LEROY (No. 427), but is certainly not synonymous with our 'Lemon Pippin' as he states. There is no doubt as to the old English 'Lemon Pippin.' It has been well figured by LINDLEY, RONALDS, HOGG, and also in the Pomologie Française, published at Lyons.

The largest foreign collection was from France and contained many interesting fruits, some of which are still grown in this country. One variety, named 'Canterbury,' I have long wished to see, as it has, as far as I can trace, no affiliation with this country, being recorded only by foreign pomologists. 'Royal d'Angleterre' is another long fathered upon England, but it seems not to be known here unless, indeed, it be our 'Royal Late,' which was found, not raised, in the Royal Gardens at Frogmore. For this there is not yet enough data for a decision.

The Belgian collection included 'Reinette Descardre,' which is grown in this country, and settled certain doubts as to its identity. Most interesting in this section was one called 'Belle Fleur large mouche,' a name I cannot attempt to translate, nor can I find it in any of the continental authors. In appearance it almost exactly resembles 'Roundway Magnum Bonum,' and the leaves and fruit buds do so too. It will, however, be necessary to wait until the fruit acquires its flavour before coming to a decision here.

It was interesting to see our 'Dutch Mignonne' under its original name, 'Grosser Casseler Reinette.'

APPLES IN ESTHONIA.

By A. JANSON.

EVERY autumn the Esthonian markets are filled with great quantities of Apples, and for 6*s*. anyone may secure for his needs a cwt. of the best dessert fruits. In March scarcely any are offered and the price is no less than 1*s*. per lb. This great variation in supplies led to the idea that possibly we could acclimatize some good foreign dessert varieties, for our existing Russian and local varieties are all of short-keeping qualities. We accordingly commenced a search for suitable varieties in 1920, first from Messrs. SPÄTH of Berlin, and later from Messrs. BUNYARD of Maidstone and Messrs. LAXTON of Bedford.

Our summer is very short. Rain, snow, frost, and bright sunlight last until the middle of May, and Apple trees can rarely show their flowers before the middle of June. At the beginning of September frosts begin again and the fruits that have not been gathered are frozen and hang upon the trees like pieces of shining ice. It is thus clear that very few varieties can thrive and ripen their wood and fruit in these conditions. Great changes of temperature and sharp frosts frequently break down the tissues of the trees and kill them. My search resolved itself into trying to find :

1. Foreign frost-proof Apple trees of the best dessert quality, of good cropping capacity, able to thrive in our climate without artificial aid.
2. Some stock capable of influencing certain varieties so that they would thrive in our climate.
3. The possibility of effecting a like purpose by double grafting.
4. The possible effect of manuring in making the trees hardier.

To give an account of the amount of laborious work these investigations entailed would take too great a space, but briefly we have found no benefit in this direction by the use of various stocks, but manuring in ordinary seasons is a help.

Of the varieties tried, one known in Germany as 'Winterdechanspirne' stood —28° C. (50° frost F.), but we are informed that it will not withstand such low temperatures in Germany.

Double grafting has proved the most valuable aid and has a greater influence than we suspected. Special attention has been given to the Canadian Apple 'Ontario,' which we received from Messrs. SPÄTH of Berlin. This variety was grafted on all our available types of stock and on various local Apples. After the cold summer of 1927 followed a very hard winter, and with the exception of two trees of 'Ontario' grafted on 'White Transparent' all were killed. The survival of these two was encouraging.

The summer of 1928 was a most pitiable one. To extremely cold weather was added ceaseless rain. The soil was turned to mud and hundreds of square miles of agricultural land was transformed into lakes, so that farmers could venture out only in boats. From January 6 a frost of unprecedented severity lasted for 2½ months. $-33°$ C. was recorded. The wood of some of the trees was so unripe that varieties such as ' Mother ' and ' Britzen Dauerappel ' were killed off at $-7°$ C. The ravages of the frost were so terrible that 250 young fruit trees had to be rooted up and burned. Notwithstanding this severity the ' Ontario ' top-grafted on ' White Transparent,' itself on stocks of *Malus baccata*, though it suffered, remained alive and is now thriving and cropping particularly well.

Crosses have been made between ' Ontario ' and ' Signe-Tillish ' and seedlings raised. It is therefore to be hoped that we may be able to secure a new frost-proof variety.

The variety ' Laxton's Superb ' has shown special hardiness, being in no way damaged by the winter just mentioned, although the local varieties ' Borstorf of Livland,' ' Borowinka (Duchess of Oldenburgh),' ' Anisówka ' and others regarded for generations as frost-proof suffered heavily and were killed on sandy and peaty soils. ' Laxton's Superb ' will not, however, " take " properly on *Malus baccata*, being liable to blow out after three or four years, and intermediate grafting is necessary for it. The best results so far have been obtained by *Malus baccata* × Antonowka × ' Laxton's Superb.' The Apple ' Laxton's Superb ' thus merits attention in even the coldest parts of the British Empire where Apples will grow at all.

There may, of course, be many valuable fruits in England deserving of trial for their hardiness. This kind of work needs much patience and time and may result in serious financial loss.

The variety ' Signe-Tillish,' of Danish origin, raised from ' Weisser Winter Kallvill,' has shown good results in Esthonia. It is very hardy, and crops well, and the fruit keeps until March. It is of the finest dessert quality at Christmas. It thrives without double grafting.

' Minister von Hammerstein ' is of German origin and is a seedling from ' Landsberger Reinette.' It is fairly hardy, a remarkable cropper, and thrives on every stock. The fruit is of good dessert quality, juicy and keeping until April.

' Treboux ' is of Esthonian origin, raised about thirty years ago at Pernau by M. Treboux, a Frenchman, teacher in the local gymnasium. It is a great cropper, bearing both on tips and spurs, and is a fruit of conspicuous beauty among other scarlet fruits. It is of good dessert quality, at its best in October and November.

'Antonowka,' an old Russian variety of good cropping quality, but inclined to biennial bearing. It is a good jam and cider fruit. It is the most extensively grown Apple in Esthonia and considerable quantities are exported to Finland for manufacturing purposes.

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